A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING

Dissertation submitted
in partial fulfillment of the regulation for the award of

M.S. Degree in Orthopaedic Surgery
Branch II

TIRUNELVELI MEDICAL COLLEGE

THE TAMILNADU

Dr. M. G. R. MEDICAL UNIVERSITY

CHENNAI – 600 032.

MAY 2018

CERTIFICATE

This is to certify that this dissertation titled **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING"** is a bonafide work done by **Dr.SANJEEV P** Postgraduate student in the department of Orthopaedics, Tirunelveli Medical College Hospital.

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This is to certify that the work entitled **“A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING”** which is being submitted for M.S.Orthopaedics, is a bonafide work of by **Dr.SANJEEV P,** Postgraduate student in the department of Orthopaedics , Tirunelveli Medical College Hospital, Tirunelveli.

He has completed the necessary period of stay in the department and has fulfilled the conditions required for submission of this thesis according to university regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us. Recommended and Forwarded

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This is to certify that the dissertation entitled **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING"** is a bonafide research work done by **Dr.SANJEEV P,** Postgraduate M.S. student in Department of Orthopaedics, Tirunelveli Medical College & Hospital, Tirunelveli, in partial fulfilment of the requirement for the degree of M.S. in Orthopaedics.

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DECLARATION

I solemnly declare that this dissertation titled **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING**" was prepared by me, at Tirunelveli Medical College Hospital under the guidance of Prof & HOD, **Prof.N.MANIKANDAN,** Tirunelveli Medical College Hospital, Tirunelveli, in partial fulfillment of Dr.M.G.R.Tamilnadu Medical University regulations for the award of M.S.Degree in Orthopaedics.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously.

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CONTENTS

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CERTIFICATE OF REGISTRATION & APPROVAL OF THE TIREC REF NO:917/ORTHO/2016

PROTOCOL TITLE : A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING.

PRINCIPAL INVESTIGATOR: Dr. P. SANJEEV, MBBS

DESIGNATION OF PRINCIPAL INVESTIGATOR: POST GRADUATE IN ORTHOPAEDICS

DEPARTMENT & INSTITUTION: TIRUNELVELI MEDICAL COLLEGE, TIRUNELVELI

Dear , Dr. P. Sanjeev, The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during the IEC meeting held on 05.08.2016.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1. TIREC Application Form ☐
2. Study Protocol ☐
3. Department Research Committee Approval ☐
4. Patient Information Document and Consent Form in English and Vernacular Language ☐
5. Investigator's Brochure ☐
6. Proposed Methods for Patient Accrual Proposed ☐
7. Curriculum Vitae of the Principal Investigator ☐
8. Insurance / Compensation Policy ☐
9. Investigator's Agreement with Sponsor ☐
10. Investigator's Undertaking ☐
11. DCGI/DGFT approval ☐
12. Clinical Trial Agreement (CTA) ☐
13. Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA) ☐
14. Clinical Trials Registry-India (CTRI) Registration ☐

THE PROTOCOL IS APPROVED IN ITS PRESENTED FORM ON THE FOLLOWING CONDITIONS

1. The approval is valid for a period of 2 year/s or duration of project whichever is later
2. The date of commencement of study should be informed
3. A written request should be submitted 3weeks before for renewal / extension of the validity
4. An annual status report should be submitted.
5. The TIREC will monitor the study
6. At the time of PI's retirement/leaving the institute, the study responsibility should be transferred to a person cleared by HOD
7. The PI should report to TIREC within 7 days of the occurrence of the SAE. If the SAE is Death, the Bioethics Cell should receive the SAE reporting form within 24 hours of the occurrence.
8. In the events of any protocol amendments, TIREC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. The PI must comment how proposed amendment will affect the ongoing trial. Alteration in the budgetary status, staff requirement should be clearly indicated and the revised budget form should be submitted.
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented.
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CERTIFICATE - II

This is certify that this dissertation work title **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING"** of the candidate **Dr. SANJEEV P**, with registration Number **221512303** for the award of **M.S.** Degree in the branch of **Orthopaedics (II).** I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion page and result shows **0 PERCENTAGE** of plagiarism in the dissertation.

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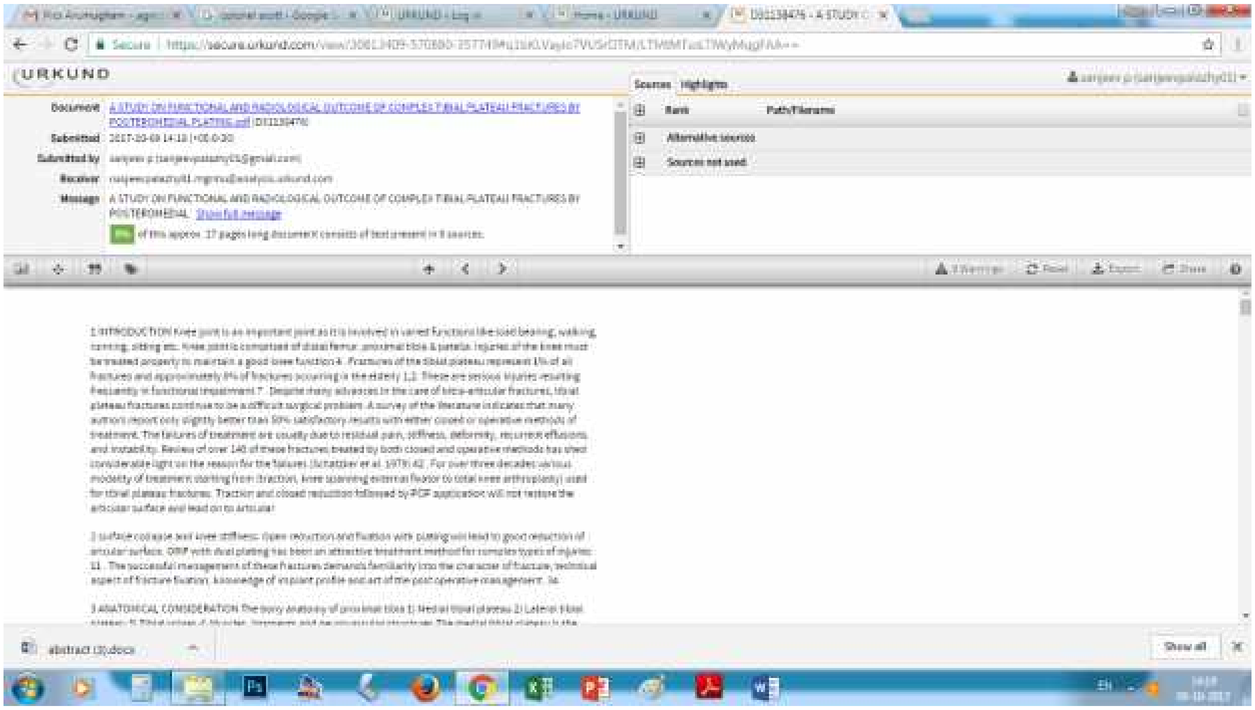
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INTRODUCTION

Knee joint is an important joint as it is involved in varied functions like load bearing, walking, running, sitting etc. Knee joint is comprised of distal femur, proximal tibia & patella. Injuries of the knee must be treated properly to maintain a good knee function[4].

Fractures of the tibial plateau represent 1% of all fractures and approximately 8% of fractures occurring in the elderly[1,2.] These are serious injuries resulting frequently in functional impairment[7].

Despite many advances in the care of intra-articular fractures, tibial plateau fractures continue to be a difficult surgical problem. A survey of the literature indicates that many authors report only slightly better than 50% satisfactory results with either closed or operative methods of treatment. The failures of treatment are usually due to residual pain, stiffness, deformity, recurrent effusions, and instability. Review of over 140 of these fractures treated by both closed and operative methods has shed considerable light on the reason for the failures (Schatzker et al. 1979)[42].

For over three decades various modality of treatment starting from (traction, knee spanning external fixator to total knee arthroplasty) used for tibial plateau fractures. Traction and closed reduction followed by POP application will not restore the articular surface and lead on to articular surface collapse and knee stiffness. Open reduction and fixation with plating will lead to good reduction of aricular surface. ORIF with dual plating has been an attractive treatment method for complex types of injuries[11].

The successful management of these fractures demands familiarity into the character of fracture, technical aspect of fracture fixation, knowledge of implant profile and art of the post operative management.[34]

AIM OF THE STUDY

To evaluate the FUNCTIONAL AND RADIOLOGICAL OUTCOME OF COMPLEX TIBIAL PLATEAU FRACTURES BY POSTEROMEDIAL PLATING in Department of Orthopaedics, Tirunelveli Medical College Hospital, over a period from June 2015 to September 2017.

REVIEW OF LITERATURE

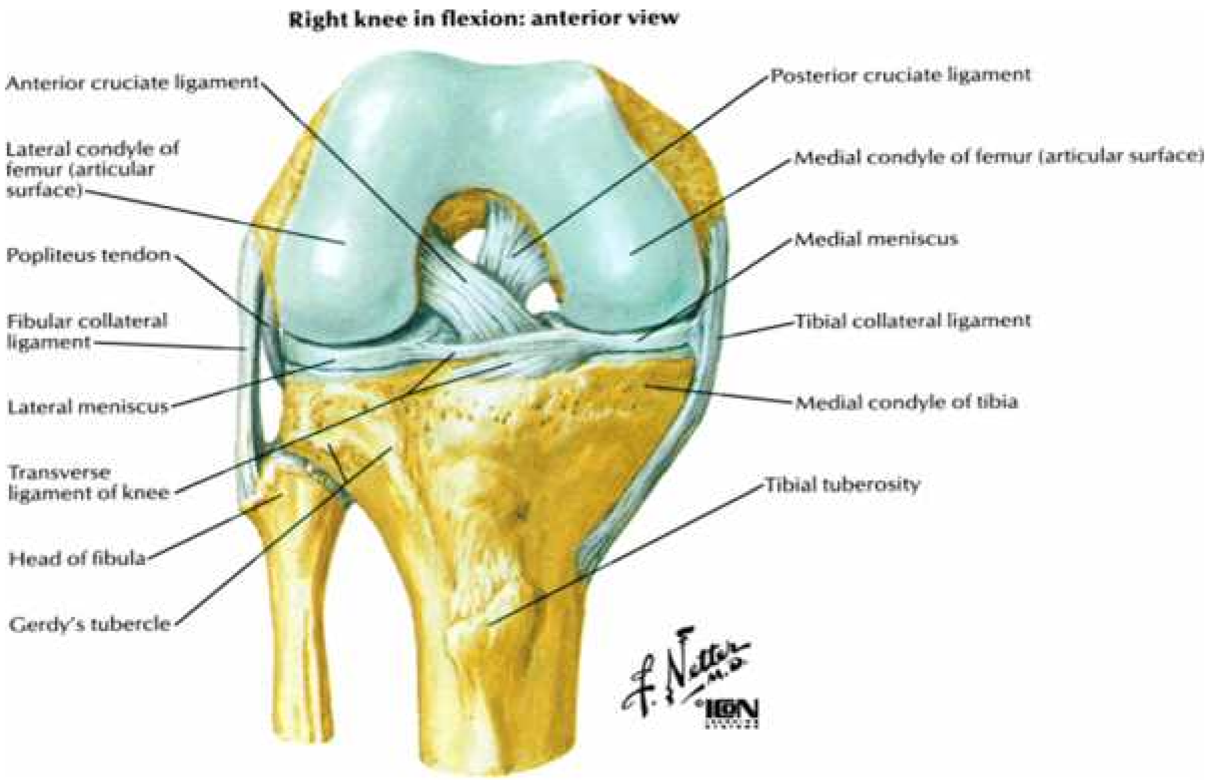
ANATOMICAL CONSIDERATION

The bony anatomy of proximal tibia

1) Medial tibial plateau
2) Lateral tibial plateau
3) Tibial spines
4) Muscles, ligaments and neurovascular structures

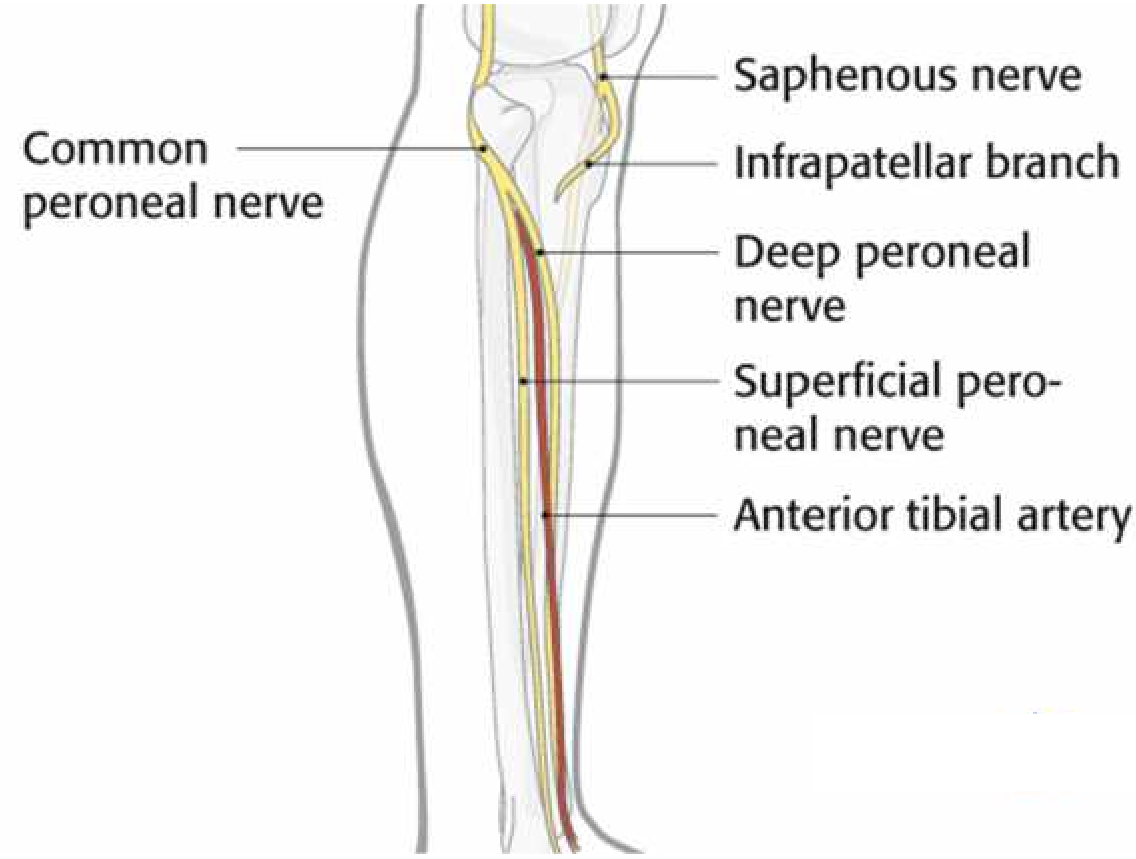
The medial tibial plateau is the larger of the two, is concave, and is covered with hyaline cartilage. The lateral plateau is smaller, convex, and is also covered in hyaline cartilage. These anatomic conditions are useful to recognize in cases when fixation is being placed percutaneously to avoid iatrogenic joint penetration. One can differentiate the lateral from the medial tibial plateau on the lateral radiographic image[9].

A fibrocartilaginous meniscus covers both plateaus. The coronary ligaments serve to attach the menisci to the plateaus and the intermeniscal ligament serves to connect the menisci anteriorly. Oftentimes, this ligament is incised and elevated to afford direct visualization of the articular surfaces. The tibial spines are between the plateaus. The medial and lateral tibial spines gives attachment points for the anterior and posterior cruciate ligaments as well as the menisci[11].



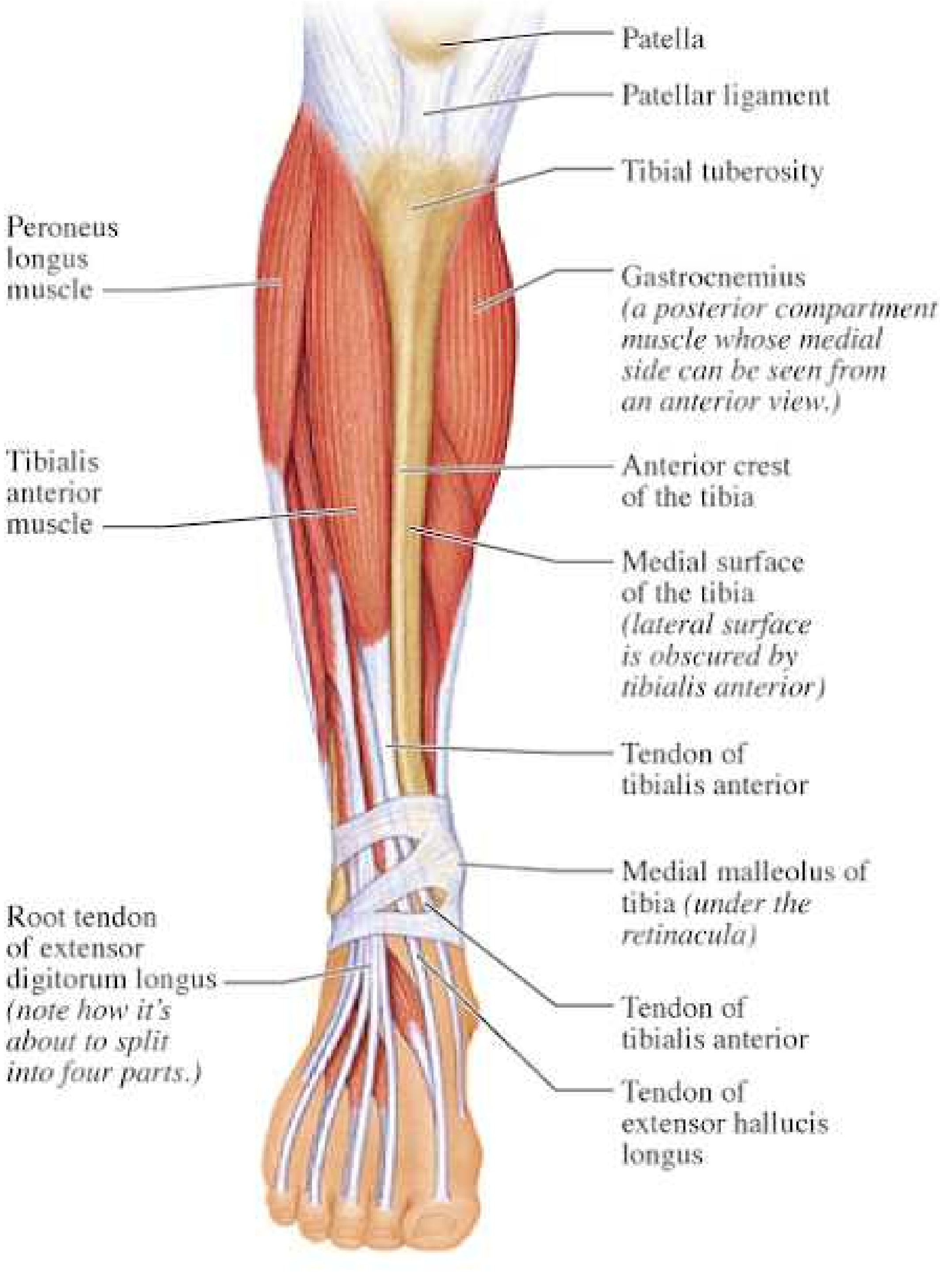
The tibia is a triangular-shaped bone in cross section in its diaphysis. Proximally, the tibial tubercle is found anterolaterally about 3 cm below the articular surface. This site serves as a point of attachment for the patellar tendon. Directly posterior to the patellar tendon is a richly vascularized fat pad. Further lateral on the proximal tibia is Gerdy's tubercle where the iliotibial band inserts. Continuing to move laterally, the proximal tibia and fibula form an articulation covered in hyaline cartilage. The medial (tibial) collateral ligament inserts into the medial proximal tibia and the lateral (fibular) collateral ligament insert to the lateral proximal tibia are instrumental in preventing varus and valgus instability, while the intra-articular anterior and posterior cruciate ligaments afford anterior-posterior stability.(1,16,19)

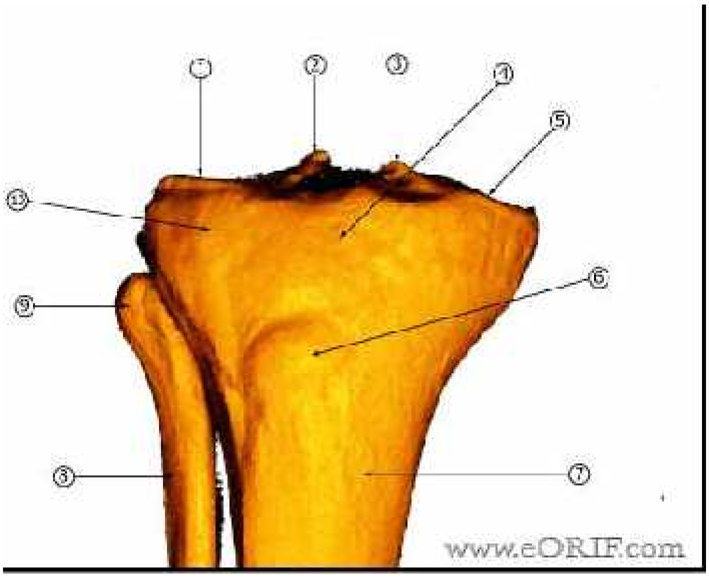
Neurovascular structures are at risk with proximal tibia fractures. The common peroneal nerve courses around the neck of the fibula distal to the proximal tibia-fibula joint before it divides into its superficial and deep branches. It is at risk with severe displacement following high-energy fractures of the proximal tibia. The trifurcation of the popliteal artery into the anterior tibial, posterior tibial, and peroneal arteries occurs posteromedially in the proximal tibia. Vascular injuries to these structures are common following knee dislocation, but can occur in high-energy fractures of the proximal tibia as well.[34]



Furthermore, knee flexion during surgery will move these vascular structures farther from the posterior aspect of the plateau.(1,2)

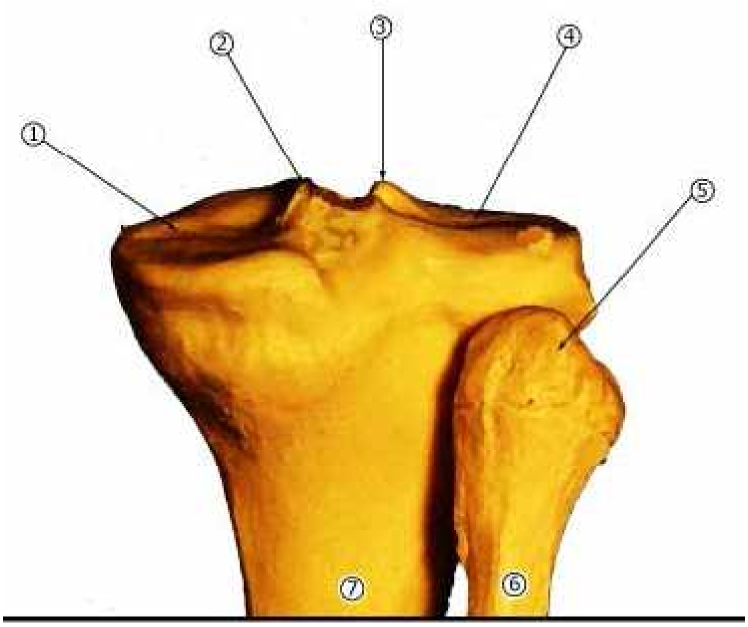
The anterior compartment musculature attaches to the proximal lateral tibia and must be carefully elevated when performing a lateral approach to the proximal tibia. The proximal medial tibial surface serves as an attachment point for the pes tendons. This thin, soft tissue envelope about the proximal medial tibia places it at risk for secondary surgical insult following a higher - energy fracture pattern[1, 17]


Patella
Patellar ligament
Tibial tuberosity
Peroneus longus muscle
Gastrocnemius (a posterior compartment muscle whose medial side can be seen from an anterior view.)
Tibialis anterior muscle
Anterior crest of the tibia
Medial surface of the tibia (lateral surface is obscured by tibialis anterior)
Tendon of tibialis anterior
Medial malleolus of tibia (under the retinacula)
Root tendon of extensor digitorum longus (note how it's about to split into four parts.)
Tendon of tibialis anterior
Tendon of extensor hallucis longus



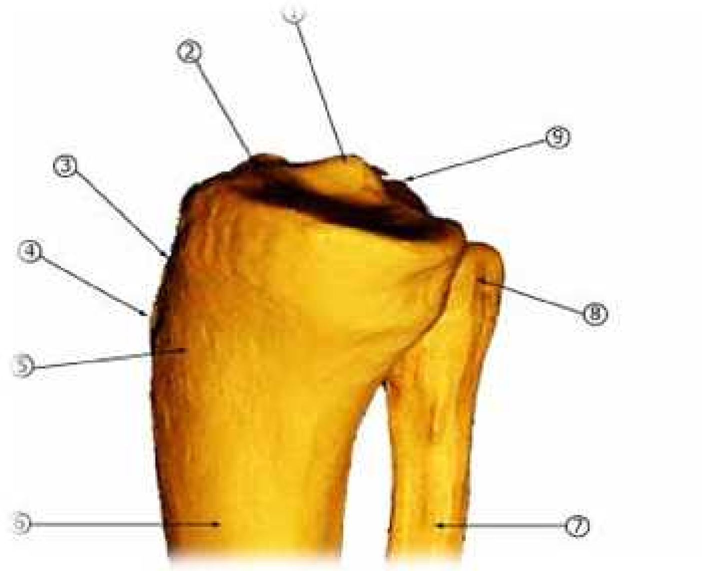
Proximal Tibia - Anterior View

1. Lateral tibial Plateau: convex, smaller than medial plateau
2. Lateral intercondylar eminence
3. Medial intercondylar eminence
4. Starting point for IM nail
5. Medial tibial plateau: concave, larger than lateral plateau
6. Tibial tubercle: insertion of patellar tendon
7. Tibial shaft
8. Fibular shaft
9. Fibular head: Styloid process of fibular head is the incertions of the lateral collateral ligament.
10. Gerdy's tubercle: insertion site of iliotibial band



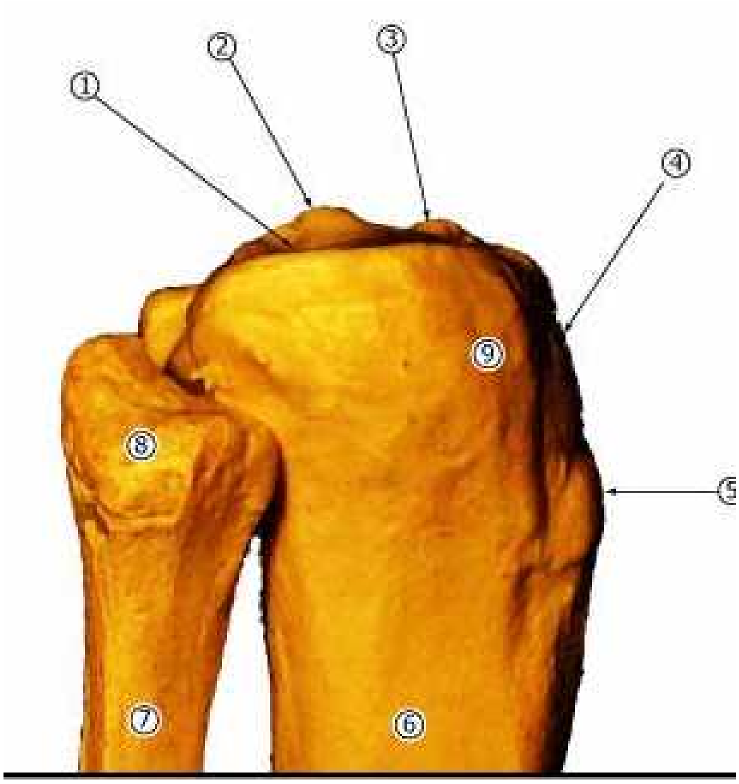
Proximal Tibia - Posterior View

1. Medial tibial plateau: concave, larger than lateral plateau
2. Medial intercondylar eminence
3. Lateral intercondylar eminence
4. Lateral tibial Plateau: convex, smaller than medial plateau
5. Fibular head: Styloid process of fibular head is the incertions of the lateral collateral ligament.
6. Fibular shaft
7. Tibial shaft



Proximal Tiba/Fibula - Medial View

1. Medial intercondylar eminence
2. Medial tibial Plateau
3. Starting point for IM nail
4. Tibial tuberosity
5. Insertion site for Pes tendons
6. Tibial shaft
7. Fibular shaft
8. Fibular head
9. Lateral intercondylar eminence



Proximal Tibia - Lateral View

1. Lateral tibial Plateau: convex, smaller than medial plateau
2. Lateral intercondylar eminence
3. Medial intercondylar eminence
4. Starting point for IM nail
5. Tibial tubercle: insertion of patellar ligament.
6. Tibial shaft
7. Fibular shaft
8. Fibular head: Styloid process of fibular head is the incertions of the lateral collateral ligament.
9. Gerdy's tubercle: insertion site of iliotibial band

Tibial plateau fractures has proved to be a fascinating therapeutic challenge for nearly two centuries of written experience. More than 1100 articles, thesis and books have documented the trial and tribulations of treating this capricious joint fracture - Hohl.

In the early period, proximal tibia fractures were treated with splins. Since the beginning of the 20th century, there has been a steadily increasing trend towards operative reduction in the treatment of proximal tibial fracture. Now the option of treatment for these fractures are varied like plates, intramedullary devices, and external skeletal fixation devices. Open reduction and internal fixation for tibial fracture was first done by Stichbach with silver plates and galvanized steel screws – 1900[20].

Fessbander did the first open reduction for tibial plateau fracture – 1901. Wilms used two nails to hold the reduction – 1910. Dehelly used grafts under surgically elevated plateau after open reduction – 1927.[24]

Tibial plateau fractures were treated predominantly by traction or immobilization in splint – early 1950s. Apley pioneered early joint rehabilitation and developed successful methods of traction that permitted early motion of joints while providing sufficient immobilization for the fracture to unite. He applied these techniques for the treatment of tibial plateau fractures and reported satisfactory results comparing with the results of surgery – 1956.[26]

AO/ASIF5 group developed atraumatic techniques of open reduction and stable fixation which permitted absolute stability of fixation and early motion without fear of displacement, malunion, or nonunion. They also developed new implants and instruments that facilitated the attainment of the new goals of ORIF- 1958.[3]

Charnley[6] recognized that anatomic reduction and early motion were desirable in the treatment of intra-articular injuries, but the techniques of surgery and internal fixation available at that time made these objectives of treatment unattainable – 1961.

Rasmussen[7] showed a high correlation between posttraumatic osteoarthrosis and residual condylar widening or discontinuity between the tibial plateau surfaces and the femoral condyles – 1973.6

Schatzker, McBroom, and Bruce8 reported their experience with surgical stabilization of select tibial plateau fractures in which 89% of patients had acceptable results – 1979.[9]

Mitchell and Shepard, in their studies of the effects of articular malreduction and unstable fixation on the outcome of articular fractures, showed that accurate reduction and stable fixation of intra-articular fragments are necessary for articular cartilage regeneration and that malreduction and instability result in rapid articular cartilage degeneration – 1980.[50]

Lansinger and colleagues[9] found good to excellent results in 90% of patients with stable knees at 20 years follow-up – 1986.

Kettlekamp[10] and co-workers suggested that the maintenance of the correct mechanical axis at the knee is a major factor in determining the functional outcome and in the prevention of osteoarthrosis – 1988.[49]

Brown indicated that elevation of contact pressure occurs in a joint when the articular step-off or incongruence is greater than 3mm – 1988.

Mast and colleagues advocated contemporary surgical techniques for more complex injuries, which included concepts[7] such as indirect reduction, antiglide fixation and composite fixation – 1989.[47]

Honkonen[11] concluded that radiographic appearance of osteoarthrosis and degenerative joint disease does not always correlate with the clinical picture – 1995.[15]

Ahmad M. Ali, Maria Burton, Munawar Hashmi, Michael Saleh, in their study on Outcome of complex fractures of the tibial plateau treated with a beam-loading ring fixation system have shown good clinical results and satisfactory radiological results – 2003.[54]

Robert D. Welch, Hong Zhang, Dwight G. Bronson in their Experimental tibial plateau fractures augmented with calcium phosphate cement or autologous bone graft have shown calcium phosphate cement may serve as a suitable alternative to autologous bone grafting for filling bone voids associated with displaced fractures of the tibial plateau – 2003.

Edwin, Geoffrey, Adam, Komal and David showed acceptable results in 82.7% patients clinically and 82.1% radiologically in their study on operative treatment of tibial plateau fractures in patients older than 55 years – 2004.[53]

Intra-articular and juxtra articular fractures are the most commonly occurring injuries. Numerous investigators have reported satisfactory reports with either closed or open methods of treatment. The out come of fracture depends upon the integrity of soft tissues.[26]

According to Barie, David ,O'Mara in frequency and fracture morphology of posteromedial fragment in tibial fracture patterns published in 2008 demonstrated 74% cases to have posteromedial fragment in bicondylar fractures.[33]

In 1997 P.Lobenhoffer, T.Gerich, T. Bertram in their article on treatment of posterior tibial plateau fractures via posteromedial exposure , states that posteromedial fracture dislocations are exposed a direct posteromedial skin incision. The posteromedial pillar and posterior flare of the proximal tibia are visualized.[49]

Luo, Cong Feng, Sun described the three – column concept and column specific fixation for complex tibial plateau fractures in 2010. They also described floating position and L shaped incision for the same.[39]

In 2009 Higgins, Thomas did a study on the incidence and morphology of the posteromedial fragment in bicondylar tibial plateau fractures and emphasized the importance of computed tomography to visualize bony fragments.

Classification

There are numerous classification systems that have been proposed to describe tibial plateau fractures. The majority of these systems are very similar, and each one recognizes wedge, compression, and bi-condylar types.

1) Hohl's classification
2) Moore classification
3) AO classification
4) Schatzker classification

First tibial plateau fracrures classified by Hohl. He divided the classification into undisplaced and displaced.

Displaced again classified into

1. Local compression
2. Split with compression
3. Total split and communitted

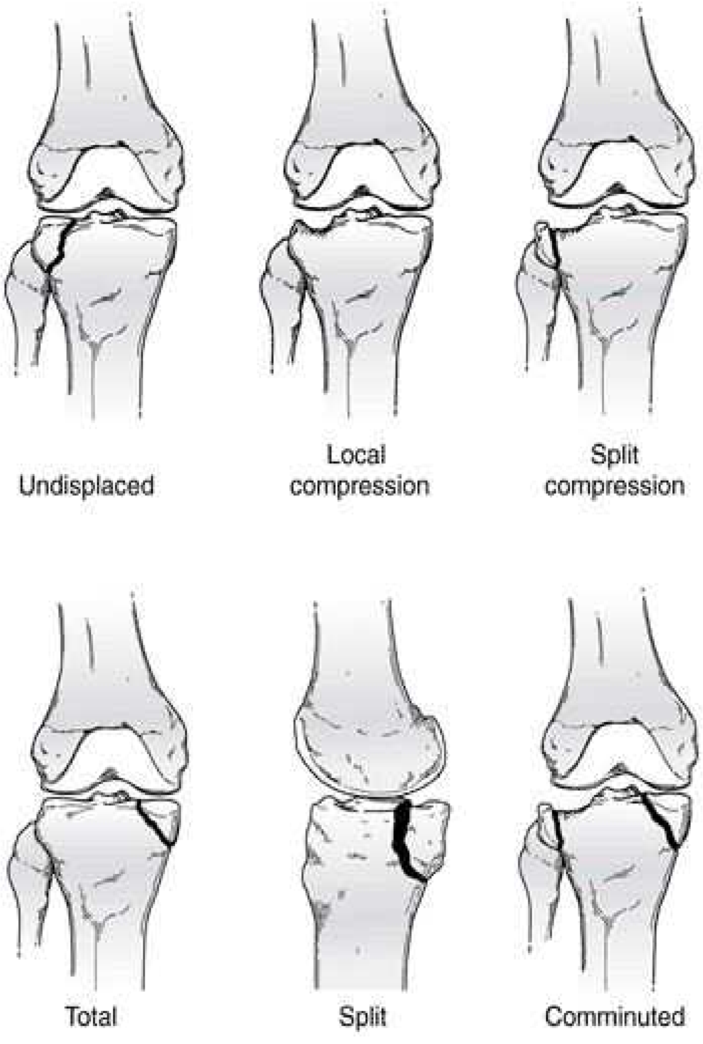


Figure1 Hohl classification

Classification by Moore

Type I	:	Medial tibial plateau split fracture in coronal plane;
Type II	:	an entire condyle fracture in which the fracture line begins in the opposite compartment and extends across the tibial eminence;
Type III	:	Is a rim avulsion fracture
Type IV	:	Is another type of rim fracture, a rim compression injury
Type V	:	Tibial plateau fractured into 4 parts with floating tibial spine

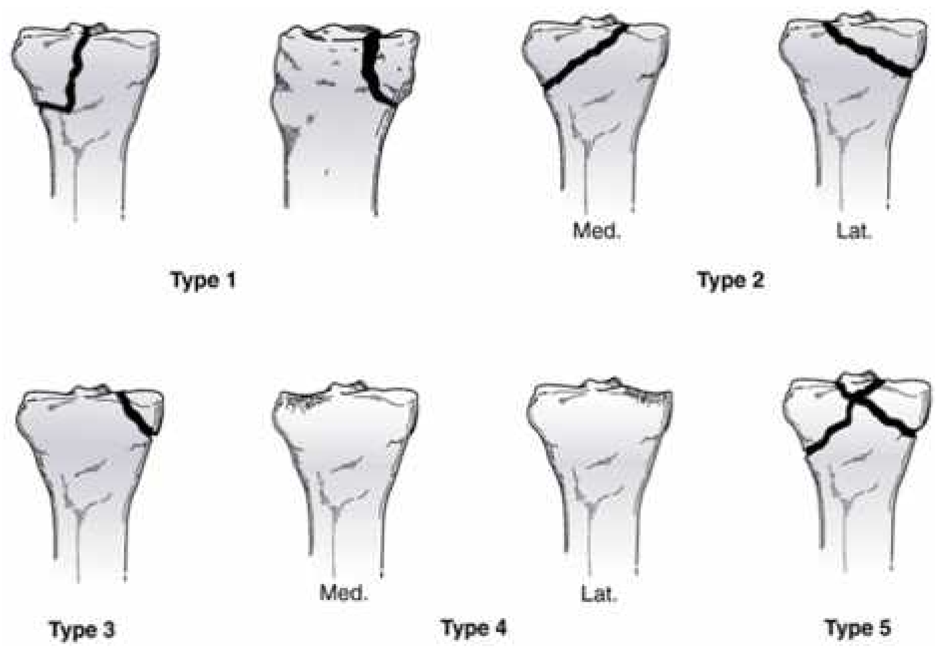


Figure 2 Moore classification

3) AO classification:

In the Orthopaedic Trauma Association (OTA) classification, which is based on the AO/ASIF, the proximal tibia is denoted as segment and is divided into three main categories.

Type A	:	Extra-articular.
Type B	:	Partial articular
B1	:	Pure Split
B2	:	Pure Depression,
B3	:	Split-Depression
Type C	:	Complete Articular Fractures
Type 1	:	Metaphyseal simple, articular
Type 2	:	Metaphyseal multifragmentary, articular
Type 3	:	Articular multifragmentary.

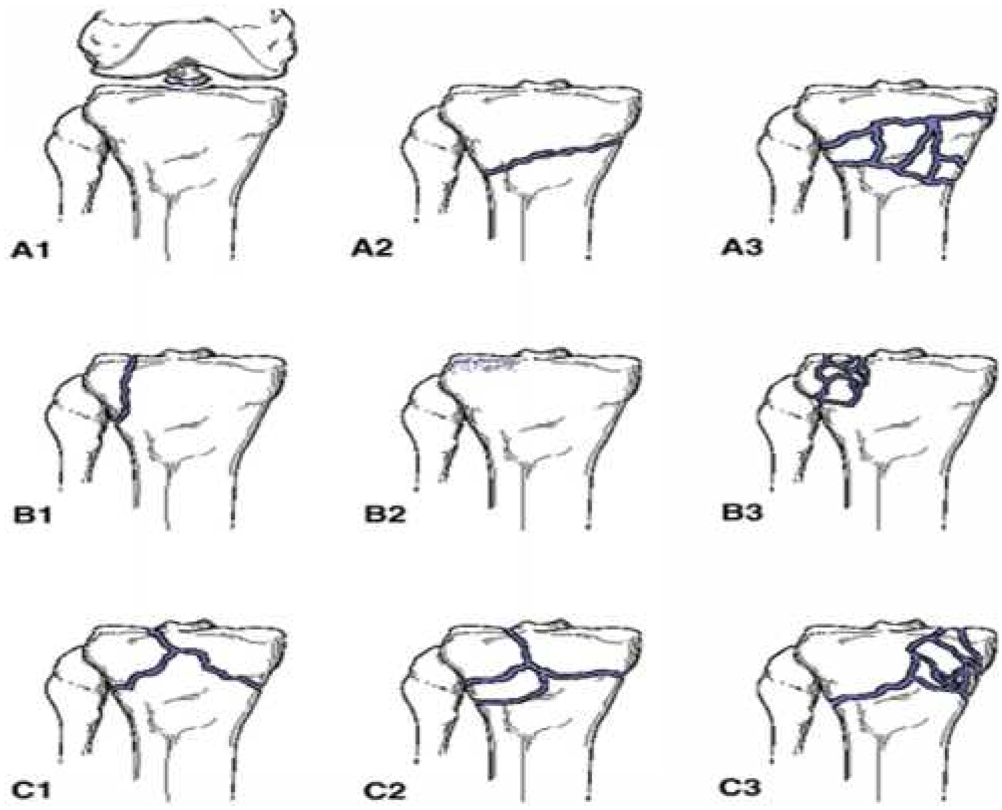


Figure 3 AO/ASIF classification

4) Schatzker classification:

Nowadays it is the most commonly used classification, because of its usefulness in decision making for tibial condyle fracture

Type I	:	Lateral condyle split fracture
Type II	**:**	Split and depression of the lateral condyle
Type III	**:**	Intact rim with pure central depression of lateral condyle
Type IV	**:**	Medial condyle fracture

Type A **:** Split fracture

Type B : Depression fracture. Both are may associated with tibial
spine fracture

Type V **:** Fracture of the both condyle

Type VI : Both tibial condyle fracture with metaphysio diaphysial dissociation(1,2)

Honkonen and Jarvinen have recently modified Schatzker's classification to take residual limb alignment into account. They divide Type VI fractures into two types; those that are medially and laterally tilted to take into account functional results in treated fractures with residual angulation.

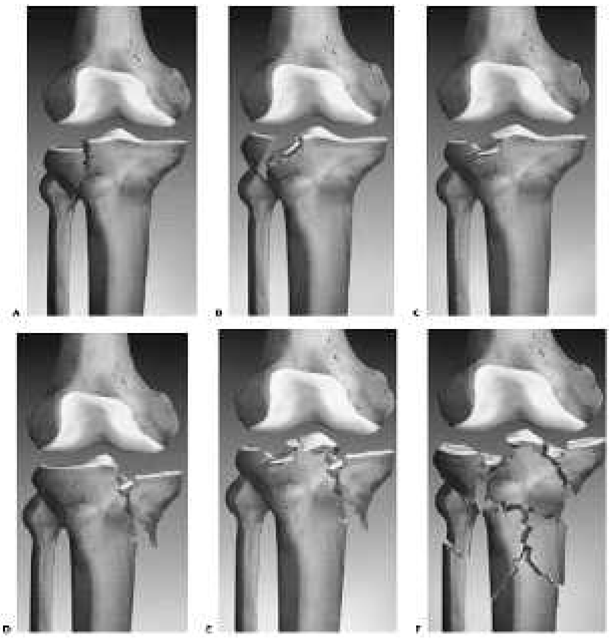
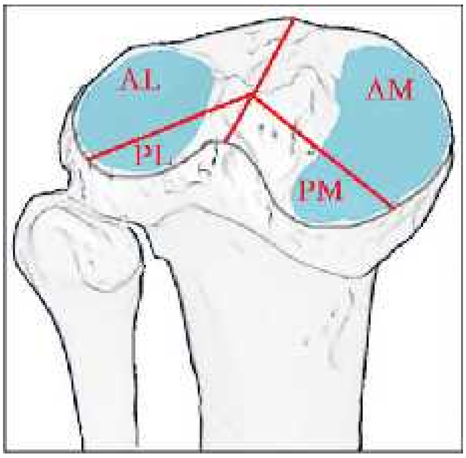
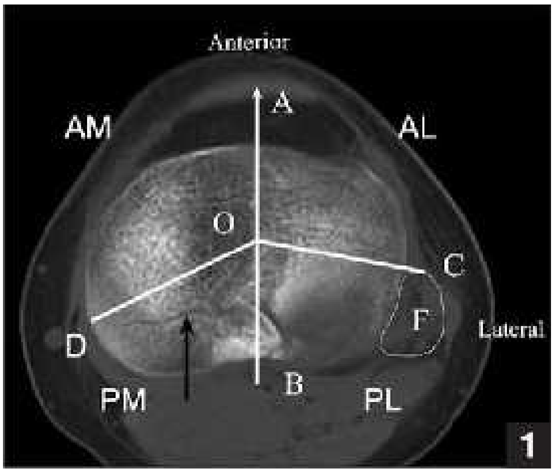


Figure 4 Schatzker classification

Three Column Concept In Proximal Tibia





Each column is an independent articular depression in the proximal tibia. There are three columns described in proximal tibia, anteromedial, anterolateral and posterior column which again is divided into posteromedial and posterolateral columns. Pure articular depression defined as zero column fracture.

Mechanism of Injury

Tibial condyles fractures caused by high velocity injuries and fall finjury from height. Most common mechanism is axial compression with valgus thrust, and the shear forces by indirect violence. Anteriormost part of femoral condyle which was wedge shaped produce axial impaction on the tibial plateau. The magnitude direction, and the force, along with the position of the knee joint, determine the location , fracture pattern, and amount of displacement. [51]

If single compartment is involved in fractures of the tibial condyle, it is usually the lateral condyle. This is due to the anatomic axis of knee , normally 7 degrees of valgus, and mostly injuries caused by a lateral- to medial-directed force. Age and bone quality also can influence the fracture pattern. Older individuals with osteoporotic bone mostly sustain depression - type fractures with intact rim because of their osteoporotic subchondral bone is not able to resist axial loads. In younger patients with good subchondral bone mostly sustain split-type fractures.

Fractures of the proximal tibia were originally described as *"the fender fracture"* as they resulted primarily from low-energy pedestrian versus car bumper accidents. Nowadays the majority of tibial plateau fractures reported in the recent literature have resulted from high-speed motor vehicle accidents and fall from height[12].

Injuries to the tibial plateau occur as a result of

- ❖ A force directed either medially (valgus deformity, the classic "bumper fracture") or laterally (varus deformity)
- ❖ An axial compressive force or
- ❖ Both an axial compressive force and bending load from the side[15].

With the knee in full extension, the anterior aspect of the femoral condyle is wedge shaped & the force generated by the injury drives the condyle into the tibial plateau.

This is because the 13 anatomic axis at the knee joint (which is normally in 7^{o} of valgus) as well as the mechanism of injury usually causes a direct force from lateral to medial. Pure split fractures are more common in younger patients, in whom the strong subchondral bone is able to withstand the compressive force of the overlying femoral condyle but the shear component of the load produces a split in the condyle with ligamentous disruption. In the elderly, osteopenic subchondral bone is no longer able to withstand compressive forces. As a result, split depression fractures become common in patients after the fifth decade. These fractures typically result from low-energy injuries, usually simple slip and fall accidents. In high-energy injuries, the forces may be so great that the plateau explodes into numerous fracture fragments. This mechanism is seen typically after a fall from a height or after a motor vehicle accident occurring with an axial load delivered to an extended knee with or without bending force. In addition to the fracture there may be associated injuries like Meniscal tear, cruciate tear, collateral ligament injury & soft tissue contusions[16].

ASSOCIATED INJURIES

Soft tissue injuries should be anticipated and routinely looked for in tibial plateau fractures especially in high-energy fracture patterns. These soft tissue injuries can have a significant effect on the functional outcome of the knee[24]. The soft tissue injuries associated with tibial plateau fractures are

- ❖ Meniscal injuries
- ❖ Ligamentous injuries
- ❖ Vascular injuries and
- ❖ Peroneal nerve injuries

One should be aware of the possibility of collateral or cruciate ligament injury in tibial plateau fractures. Tender areas usually on the opposite side of fracture along the course of the ligament suggests a ligament injury. Stress testing is better examined preoperatively under anesthesia along with the stress Xrays.[17]

Instability can be either due to ligament injury or fracture itself. If stress X-ray shows widening of the joint space, culprit is usually the collateral ligament. Treatment is usually decided upon the degree of the instability after fracture fixation. If the instability is more than 10 degrees ligament repair is considered[9,25.21]

Cruciate ligament injuries can occur especially in split compression fractures, which have to be treated accordingly. Ruptures of the anterior cruciate have been reported in upto 23% of high-energy injuries[12].

Meniscus is the most vulnerable soft tissue in tibial plateau fractures. The incidence of meniscal injuries is upto 50%[12]. With the advent of arthroscope and pre-op MRI the incidence can still go high. The diagnosis is usually made during the surgery or arthroscopic examination. Meniscal injuries are not serious enough in relation to the osseous injuries to be clinically important or they healed during treatment of fractures. Only the irreparably damaged meniscus has to be excised. Routine removal of meniscus is not recommended for fracture visualization. Peripheral suturing, minor trimming can salvage most torn or displaced meniscus16. Popliteal artery is at risk at the level of trifurcation, since this is the fixed part of the artery. Periodic observation of the circulatory status is essential since obstruction can occur within few days of injury. Either direct trauma or stretch can damage the Peroneal nerve.

Injury to the collateral ligaments has been reported to occur in 7% to 43% of tibial plateau fractures. Meniscal injuries have been reported in up to 50% of tibial plateau fractures; in split-type fractures, the meniscus may be incarcerated within the fracture site. Ligamentous injuries may be difficult to diagnose on initial examination during the acute phase. Varus and valgus stress testing of the knee in near-full extension can be performed under fluoroscopy with sedation in the emergency department or under general anesthesia in the operating room (33). Any widening of the femoral-tibial articulation greater than 10A° upon stress examination indicates ligamentous insufficiency. Split fractures of the lateral plateau have a relatively high incidence of associated ligamentous injury because the dense cancellous bone associated with split fractures does not compress. Energy is therefore not dissipated and the force is imparted to the medial collateral ligament.[4]

Metaphyseal–diaphyseal dissociation patterns and fracture dislocations are such injuries that are at particular risk for vascular or neurologic injury. Certain types of tibial plateau fractures have a high risk for compartment syndrome. Medial condylar fracture dislocations treated with temporary external fixation and Schatzker VI patterns in particular were shown to have a high rate of compartment syndrome. 10% of all tibial plateau fractures were diagnosed with an associated compartment syndrome and the risk was particularly high in the high-energy fractures with 30% in Schatzker VI patterns.

The compartments of the lower leg should be evaluated with serial examinations for signs of compartment syndrome. Presence of the well-recognized signs, including tense compartments and pain with passive stretching, should raise the suspicion of an associated compartment syndrome, and measuring compartment pressures is indicated. If the diagnosis is clear on physical examination fasciotomy may be performed without pressure measurements. Patients who have high-energy fracture patterns, who are not able to provide a history, and who are difficult to examine should have compartment pressures measured at presentation and these measurements may need to be repeated based on the clinical findings and the results of the initial measurement. Tibial plateau fractures may have communicating open wounds, which need to be identified on physical examination of the injured limb.

A well-aligned limb is important to the eventual outcome of patients with tibial plateau fractures. The eventual alignment of the knee after fracture healing is determined by a combination of the presence or absence of extra-articular fracture deformity, residual articular depression, and knee instability. Initial assessments of limb alignment are frequently made based on the appearances of the fracture on radiographs, but deformity may be apparent on inspection. In lateral tibial plateau fractures assessing for valgus instability of the knee may provide a guide to the need for surgical treatment. If instability is present it is likely caused by fracture displacement and will not resolve without reducing the fracture. However, pain from the injury often makes it difficult to examine the knee for coronal instability, limiting the value of this assessment.

In all patients, particularly when an open reduction is planned, the soft tissue envelope around the knee must be carefully examined. The timing, and in some fractures, the type of surgical approach will be dictated by this examination. High energy tibial plateau fractures have a significant risk of soft tissue complications from surgical approaches, so the examination of the soft tissues is very important. Important features of the soft tissues are the severity of swelling, visible contusions, and the size, character, and location of fracture blisters

INVESTIGATIONS:

Radiographic evaluation includes the standard knee trauma series of an

1) Anterior-Posterior view

2) Lateral view

3) Internal And External Oblique Views,

4) Plateau View.

1 Anteroposterior view.

(A) For **AP view** Patient supine, with the knee fully extended and the leg in the neutral position. The central beam is directed vertically to the knee with 5° to 7° cephalad angulation. (B) The radiograph in this projection sufficiently demonstrates the medial and lateral femoral and tibial condyles, the tibial plateaus and spines, and both the medial and lateral joint compartments. The patella is seen en face as an oval structure between the femoral condyles.

Lateral view. (A) patient is lying flat on the same side as the affected knee, which is flexed approximately 25° to 30°. The central beam is directed vertically toward the medial aspect of the knee joint with approximately 5° to 7° cephalad angulation. (B) The film in this projection demonstrates the patella in profile, as well as the femoropatellar joint compartment and a faint outline of the quadriceps tendon. femoral condyles are seen overlapping, and the tibial plateaus are imaged in profile.

Note the slight posterior tilt of the tibial plateaus, which normally measures approximately 10°

Tunnel view. (A) For the tunnel (or notch) projection of the knee, the patient is prone with the knee flexed approximately 40°, with the foot supported by a cylindrical sponge. The central beam is directed caudally toward the knee joint at a 40° angle from the vertical. (B) The film in this projection demonstrates the posterior aspect of the femoral condyles, the intercondylar notch, and the intercondylar eminence of the tibia.

Because of the 10 to 15 degrees posterior slope of the tibia's articular surface, these views may not be accurate in determining articular depression. Therefore, a 10 to 15 degrees caudally tilted plateau view should be used to assess articular step-off. A physician-assisted traction view is often helpful in higher-energy fractures with severe impaction and metadiaphyseal fragmentation.

The ligamentotaxis afforded by gentle in-line traction often reduces the split components and can give the treating physician added information about the fracture pattern prior to computed tomography (CT) scan or temporizing fixation. In addition to providing an assessment of the fracture patterns, radiographs often provide evidence of associated ligamentous injury. Avulsion of the fibular head and the Segond sign (lateral capsular avulsion) are signs of associated ligamentous injury, whereas the Pellegrini-Stieda lesion (calcification along the insertion of the medial collateral ligament) is seen late and represents injury to the medial collateral ligament.(13)

Computed tomography:

The role of CT in evaluation of tibial plateau fractures has been well established. CT provides optimal visualization of the plateau depression, defects, and split fragments. It also proved more accurate than conventional tomography in assessing depressed and split fractures when they involved the anterior and posterior border of the plateau, and in demonstrating the extent of fracture comminution. According to Rafii and coworkers, the degree of fracture depressions and separation as measured by the computerized technique is often more accurate than measurements obtained from conventional tomogramsn

3D computed tomography:

Particularly useful are reformatted images in various planes and three-dimensional (3-D) reformation

MRI

MRI was equivalent or superior to two-dimensional (2-D) CT reformation for depiction of tibial plateau fracture configuration . The multiplanar capabilities of MRI may facilitate 3-D perception and, in addition, this technique permits assessment of the associated injuries to the ligaments and menisci that are not visible on CT scans

An important feature of tibial plateau fractures is their association with injury to ligaments and the menisci. The structures most at risk are the medial collateral and the anterior cruciate ligaments and the lateral meniscus because lateral tibial plateau fractures usually result from valgus stress .Moreover, damage to the anterior cruciate ligament may be associated with avulsion of the lateral tibial spine or the anterior intercondylar eminence. Stress views and MRI usually reveal these associated abnormalities. If clinical examination and radiologic studies, including stress views, show ligamentous structures to be intact, then nondisplaced fractures of the tibial plateau can be treated conservatively. In depression-type fractures, however, Larson recommends open reduction in patients whose fractures show 8 mm of articular depression. Generally, surgery is indicated for fractures of the tibial plateau showing articular depression of 10 mm or more.[1,2]

Principles of management:

There are number of factors which play a dynamic role in determining the type of management influencing the prodnosis. They include

1. Type of fractures
2. Degree of articular depression
3. Degree of displacement
4. Bone quality
5. Extent of soft tissue injury
6. Presence of multiple trauma
7. Associated neurovascular injuries
8. Magnitude of joint involvements
9. Degree of comminution

So the objectives of treatment of tibial plateau fractures are

1. To restore the articular congruity
2. To achive axial alignment, joint stability,
3. To regain functional range of movements of knee joint
4. To treat the associated injuries

Methods of treatment:

There are various options for treating an adult with a fracture

1. Conservative treatment
2. Surgical treatment
    a) Percutaneous cancellous screw fixation
    b) ORIF with lateral buttress plating
    c) ORIF with medial buttress plating
    d) ORIF with double plating
    e) ORIF with locking compress plate
    f) Knee spanning external fixator
    g) Hybrid external fixator

Surgical treatment:

Indication for surgery:

1. If depression or displacement exceeds 10 mm, surgery to elevate and restore the joint surface is indicated
2. If the depression is 5 to 8 mm, If a patient is young or active, attempts at surgical reconstruction of the joint surface are justified**.**
3. More than 5 degrees of axial malalignment

If the depression is 5 to 8 mm if a patient is elderly and sedentary, nonoperative treatment usually is suitable.

Percutaneous cancellous screw fixation

Type I split fractures can generally be reduced closed with traction via ligamentotaxis with a large tenaculum clamp[61,68,78,113]. If unable to achieve an anatomic closed reduction, consider an incarcerated meniscus. Once reduced, this fracture pattern is stabilized with 6.5 to 7.3-mm cancellous lag screws with washers to gain compression [8,10,61]. An arthroscopic evaluation may be utilized to directly visualize the meniscus and articular reduction. If unable to achieve an anatomic reduction, perform an open reduction with exploration of the meniscus[5]

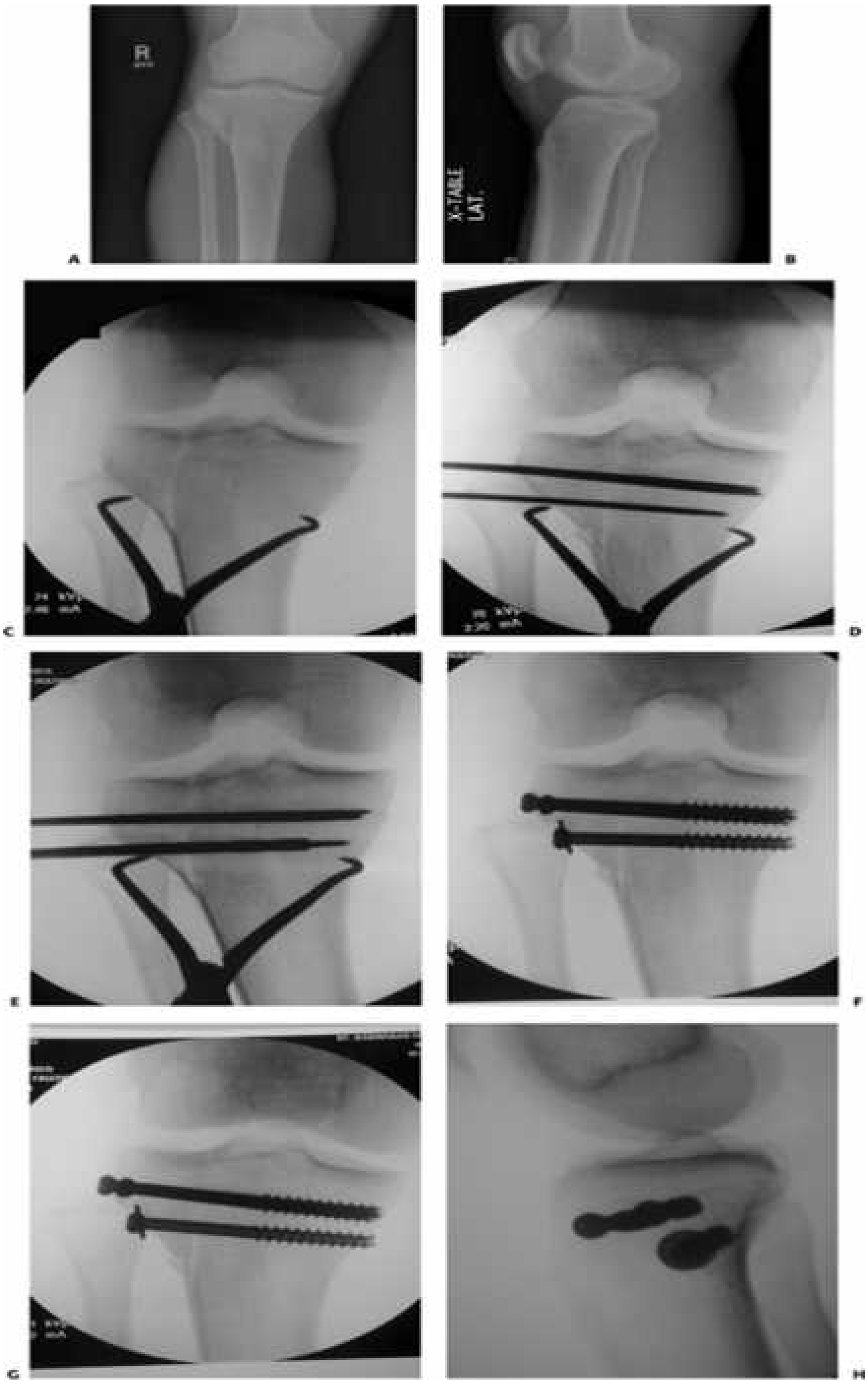


Figure 5 Percutaneous cancellous screw fixation

ORIF with plating:

Plates have two functions when used for the treatment of tibial plateau fractures. They can act as a buttress against shear forces or function in a capacity to neutralize rotational forces. Due to the tenuous soft tissue envelope around the proximal tibia, use of thinner plates has been advocated. Recently, percutaneous plating, which is a more biologic approach, has been described. In this technique, the plate is slided subcutaneously without soft tissue stripping. Some surgeons have advocated against double plating the tibial plateau due to an increase in soft tissue complications.

Figure 6 ORIF with single plating

These complications are more likely to be a result of the higher-energy injury resulting in greater soft tissue injury than from double plating. One may need to use double plates for a bicondylar fracture if the far cortex has an unstable fracture pattern; the use of low-profile plates with minimal soft tissue devitalization through a separate incision is recommended. Newer implant designs have introduced the concept of anatomically precontoured plates that are low profile and designed to fit the proximal tibia and reduce the late complication of prominent hardware. Furthermore, the trend has been to move toward smaller-diameter, fully threaded 3.5 mm lag screws placed in a raft configuration[1] which allows the screws to be placed closed to the subchondral bone

This arrangement accomplishes two functions: the first is to support the elevated osteochondral segment and the second is to lag the split component together

Figure 7 ORIF with DUAL PLAT

External Fixation

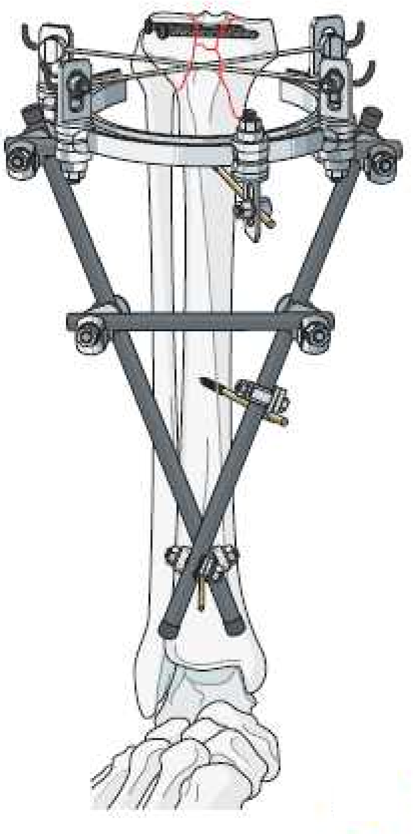


Figure:9 External Fixation

External fixation can involve half-pins, thin wires, or a combination of the two (hybrid). External fixators may be placed across the fracture such that thin wires, with or without olive beads, capture fracture fragments or cross the knee joint in a bridging fashion to make use of ligamentotaxis. The key is to place the pin or wire 10 to 14 mm below the articular surface to avoid penetration of the synovial recess posteriorly. Pin placement in this fashion will help to minimize the development of septic arthritis from a pin tract infection. Anatomical studies have shown cadavers to have some communication between the tibiol-fibular joint and the knee joint. Thus, a transfibular wire could potentially seed the knee joint if a pin tract infection were to develop. Smooth wires should be placed parallel to the articular surface and below any percutaneously placed screws. If an Ilizarov construct is used, half pins or wires are placed into the intact tibial diaphysis below the fracture(7)

Advantages of external fixation include minimal soft tissue dissection and the ability to alter frame stiffness and thus control compression across comminuted fracture fragments. These frames can be dynamized during fracture healing, which may help if delayed or nonunion occurs in the metaphyseal regions. Furthermore, external fixation provides excellent stability in cases where there is severe soft tissue or bony defect. Finally, external fixation allows for correction if there is a malalignment or deformity.(12,17,26)

Complications:

Early Complications

The most severe complication that occurs with operative treatment of tibial plateau fractures is infection. Infection rates range from 3% to 38% depending on which technique is employed. Superficial infections occur in 3% to 38% of cases and deep wound infections in 2% to 9.5% of cases. Pin tract infections are common when external fixation is utilized for tibial plateau fractures and may be seen in up to 33% of cases [20,29,30]. The concern here is the development of septic arthritis if there is communication between the pin or wire and the knee joint capsule. Skin slough is a risk factor for late infection and is of particular concern in the proximal leg secondary to poor soft tissue coverage. Factors relating to skin slough include poor surgical timing and improper soft tissue techniques with extensive osseous devitalization and the use of bicondylar implants.[20]

Thromboembolic complications occur following operative treatment of tibial plateau fractures. Deep vein thrombosis rates are reported to be 5% to 10% [7,28], and pulmonary embolus occurs in 1% to 2% of patients [7,28]. Deep vein thrombosis prophylaxis includes the use of compression stockings, low-molecular-weight heparin or Coumadin; aggressive treatment of suspected pulmonary embolus is critical.

Late Complications

Late complications include painful hardware, loss of fixation, posttraumatic arthritis, and malunion. The most common late complication following operative treatment of tibial plateau fractures is symptomatic hardware, and the reported range is between 10% to 54% . Hardware may be removed 1 year after the initial treatment. Loss of fixation is a complication that can be minimized by proper preoperative planning. Improper use of implants and/or the failure to adequately utilize bone graft or bone graft substitutes to buttress the articular surface may lead to a loss of reduction. Posttraumatic arthrosis may result from the initial chondral damage or may be related to residual joint incongruency. Satisfactory functional results can be obtained in the face of poor radiographic results, however, and may be due to preservation of the meniscus and its ability to bear the load of the lateral compartment. Malunion can occur either intra-articularly because of inadequate reduction, due to loss of reduction, or with respect to the articular surface to the tibial shaft. Results of patients with malunions and residual varus or valgus of greater than 10A° have been correlated with poor long-term functional results. Rare complications include popliteal artery lacerations, osteonecrosis, and nonunion.[31]

Implant profile

PREOPERATIVE PLANNING

Proper preoperative planning should be performed, including standard history taking ,examination of the patient to find out other associated injuries including neurovascular assessments , complete radiological examination.

CT scan mandatory for all severe tibial plateau fractures. 3D reconstructive computerized tomography may be needed in some cases to visuvalise the fracture fragments. Ensure that all needed equipment is available, such as a tourniquet, a femoral distractor, osteotomes, bone tamps, suture anchors, bone graft substitutes, small and/or large fragment standard or periarticular plates and screws or devices of choice.

Procedure:

Patients undergoing surgical repair of a posteromedial fracture of the tibial plateau through the posteromedial approach are placed in the supine position on a regular table, with the ipsilateral leg extended with contralateral hip elevated. Leg is prepared with pneumatic tourniquet inflated after exsanguination.

Surgical landmarks for the approach to the knee joint include the flexion crease of the knee and the medial head of the gastrocnemius muscle. The surgical incision is a straight, vertical incision just on the lateral side of the medial head of the gastrocnemius muscle. An incision of about 10 to 15 cm in length (depending on the distal fracture extension and length of the required buttress plate) is made vertically in the skin along the border of the medial head of the gastrocnemius muscle, to avoid crossing the popliteal fossa proximally.

The subcutaneous tissue and popliteal fascia are dissected sharply, the long saphenous vein, saphenous nerve are protected. Dissection continued between ansa cervicalis and lateral border of medial head of gastrognemus. Throughout the procedure, all neurovascular structures are retracted laterally under protection of the medial head of the gastrocnemius.

There is no “true” interneural plane during the surgical dissection. The medial border of the medial gastrocnemius is identified by blunt dissection in a distal-to-proximal direction and is retracted laterally through the careful subperiosteal placement of a Hohmann retractor at the level of the lateral cortex of the proximal tibia. Specifically, the periosteum is incised on the medial border of the proximal tibial metaphysis, with a No. 11 scalpel blade, and is carefully elevated . The Hohmann retractor is then positioned in the subperiosteal plane retracting gastrognemus. This maneuver must be performed carefully to avoid indirect shearing injuries to the neurovascular bundle of the popliteal fossa. The posteromedial fracture fragment is then visualized.

Fracture Reduction and Fixation ; When the fragment of a posteromedial fracture of the tibial plateau is visualized, it can be indirectly reduced through the following maneuver(s): (1) hyperextension of the knee with axial traction over a bump placed under the thigh, proximal to the knee; (2) direct axial compression of the posteriorly displaced fragment through the use of a ball spike pusher; and (3) application of a T-shaped posteromedial buttress plate, with the first screw inserted through the plate and into an oblong hole at the apex of the fracture, allowing indirect reduction of the fracture by approximation of the plate to the bone with a nonlocking cortical screw. After application of the T-plate, its proximal section is temporarily held in place with one or two 1.6-mm Kirschner wires through the designated holes in the plate. [32]

This will avoid accidental rotation of the plate by torque from the first screw applied through the shaft of the plate ("helicopter effect") and, under fluoroscopic guidance in the lateral plane, will ensure perfect cephalad placement of the plate . The plate used for fixation of the fracture fragment is a posteromedial LCP[31]

The length of the plate should be such as to accommodate at least three or four plate holes distal to the apex of the fracture. Therefore, the length of the surgical incision made for reduction of the fracture depends on the length of the selected plate. Adequacy of the plate position and fracture reduction are confirmed fluoroscopically, after which additional screws are placed through the shaft of the plate. In order not to jeopardize adjunctive reduction and plating of the lateral tibial plateau if the latter measures are needed, the proximal screw holes in the horizontal section of the T-plate are filled with additional locking head screws only if the plate is used as a stand-alone device .[30]

Wound Closure and Rehabilitation Closure of the surgical wound made for the posterior approach to a posteromedial fracture of the tibial plateau is simple and straightforward, because the approach is very biologic and the buttress plate used for fracture reduction is completely covered by the medial gastrocnemius muscle. Placement of drain is required. Closure of the subcutaneous tissue layer and the closure of the skin with staples.

A sterile dressing is applied . If adjunctive fixation of the lateral tibial plateau is required, such as in the case of bicondylar fractures, the leg is prepared and managed as needed for a standard approach to fracture fixation through an anterolateral approach or with percutaneous lateral-to-medial lag screws.

CRITERIA FOR RASMUSSEN RADIOLOGIC ASSESSMENT:

	SUBJECTIVE	SCORE
ARTICULAR DEPRESSION	None	6
	<5mm	4
	6-10mm	2
	>10mm	0
CONDYLAR WIDENING	None	6
	<5mm	4
	6-10mm	2
	>10mm	0
VARUS AND VALGUS ANGULATION	None	6
	< 10°	4
	10° - 20°	2
	> 20°	0
MAXIMUM	Maximum	18
Results	Excellent	18
	Good	12-17
	Fair	6-11
	Poor	<6

Oxford Knee Scoring System

1. How would you describe the pain you usually have in your knee?	7. Could you kneel down and get up again afterwards?
None	Yes, easily
Very mild	With little difficulty
Mild	With moderate difficulty
Moderate	With extreme difficulty
Severe	No, impossible

2. Have you had any trouble washing and drying yourself (all over) because of your knee?	8. Are you troubled by pain in your knee at night in bed?
No trouble at all	Not at all
Very little trouble	Only one or two nights
Moderate trouble	Some nights
Extreme difficulty	Most nights
Impossible to do	Every night

3. Have you had any trouble getting in and out of the car or using public transport because of	9. How much has pain from your knee interfered with your usual work? (including housework)

your knee? (With or without a stick)	
No trouble at all	Not at all
Very little trouble	A little bit
Moderate trouble	Moderately
Extreme difficulty	Greatly
Impossible to do	Totally
4. For how long are you able to walk before the pain in your knee becomes s eve re? (With or without a stick)	**10. Have you felt that your knee might suddenly ï¿½give awayï¿½ or let you down?**
No pain > 60 min	Rarely / Never
16 - 60 minutes	Sometimes or just at first
5 - 15 minutes	Often, not at first
Around the house only	Most of the time
Not at all - severe on walking	All the time

5. After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee?
Not at all painful
Slightly painful
Moderately pain
Very painful
Unbearable

6. Have you been limping when walking, because of your knee?
Rarely / never
Sometimes or just at first
Often, not just at first
Most of the time
All of the time

11. Could you do household shopping on your own?
Yes, easily
With little difficulty
With moderate difficulty
With extreme difficulty
No, impossible

12. Could you walk down a flight of stairs?
Yes, easily
With little difficulty
With moderate difficulty
With extreme difficulty

Grading for the Oxford Knee Score	
Score 0 to 19	May indicate severe knee arthritis. It is highly likely that you may well require some form of surgical intervention, contact your family physician for a consult with an Orthopaedic Surgeon.
Score 20 to 29	May indicate moderate to severe knee arthritis. See your family physician for an assessment and x-ray. Consider a consult with an Orthopaedic Surgeon.
Score 30 to 39	May indicate mild to moderate knee arthritis. Consider seeing your family physician for an assessment and possible x-ray. You may benefit from non-surgical treatment, such as exercise, weight loss, and /or anti-inflammatory medication
Score 40 to 48	May indicate satisfactory joint function. May not require any formal treatment

PREAMBLE

Tibial plateau fractures are one of the commonly occurring fracture in people with various ages . Eventhough various modality of treatment available, the functional results are not upto the satisfactory level especially tibial plateau fractures with a posteromedial fragment.

This series include 20 cases of tibial plateau fractures with posteromedial column fracture, all are fixed with posteromedial plating .the outcome was analysed by the range of movements, pain and bony union. Based on the findings we hereby submit A Study On Functional And Radiological Outcome Of Complex Tibial Plateau Fractures By Posteromedial Plating.

MATERIALS AND METHODS

This is a prospective study of 20 cases of tibial plateau fractures (schatzker type 4,5 and 6) surgically fixed with posteromedial plating and If adjunctive fixation of the lateral tibial plateau is required, such as in the case of bicondylar fractures, the leg is prepared and managed as needed for a standard approach to fracture fixation through an anterolateral approach or with percutaneous lateral-to-medial lag screws.

The period of study and follow up extents from June 2015 to September 2017.

MATERIALS

Twenty patients were randomly selected from the admissions in the accident ward in Department of Orthopaedics in Tirunelveli Medical College Hospital, Tirunelveli and recruited into the study prospectively based on the following criterias

INCLUSION CRITERIA:

1. Age above 20 years
2. Closed Tibial plateau fractures (Schatzker type4, 5 and type 6) with posteromedial column fracture

EXLUSION CRITERIA:

1. Age less than 20 years
2. Patients with co-morbid medical condition
3. Compound Tibial plateau fractures
4. Late cases with joint stiffness
5. Late cases with infection
6. Cases of more than 30 days duration

ANALYSIS OF FUNCTIONAL OUTCOME

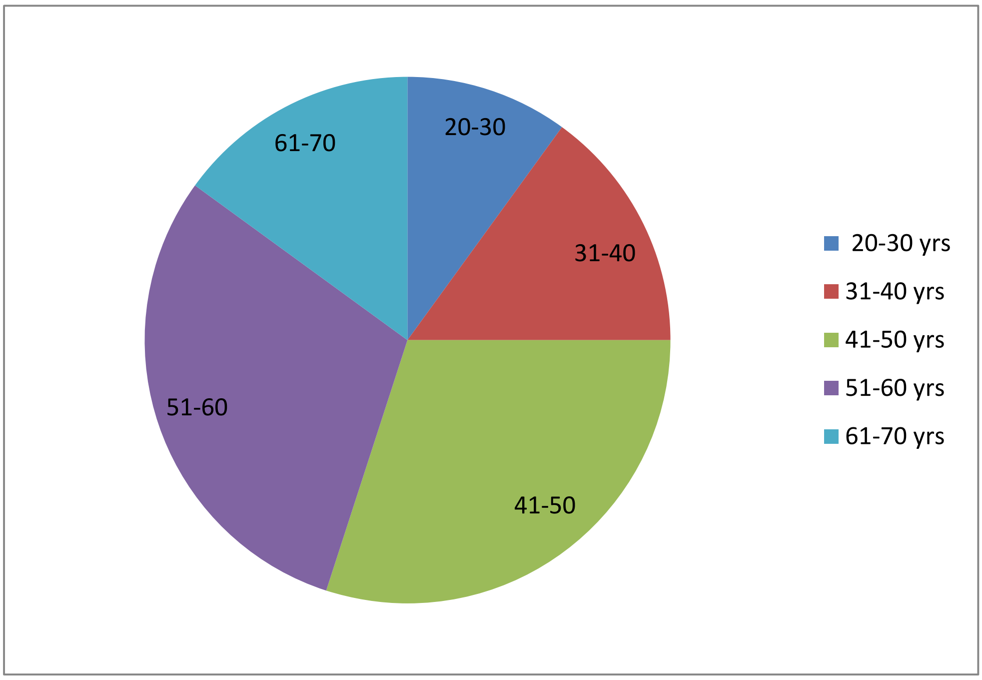
All the cases were analysed as per the following criteria

1. Age distribution
2. Sex distribution
3. Side of injury
4. Mode of injury
5. Classification of fractures
6. Time interval between injury and surgery
7. Associated injuries
8. Complications

I. AGE DISTRIBUTION:

The Age group varied from 20 to 70 years with mean age of 45 years. Incidence of fracture was observed maximum between 40 to 60 years of age

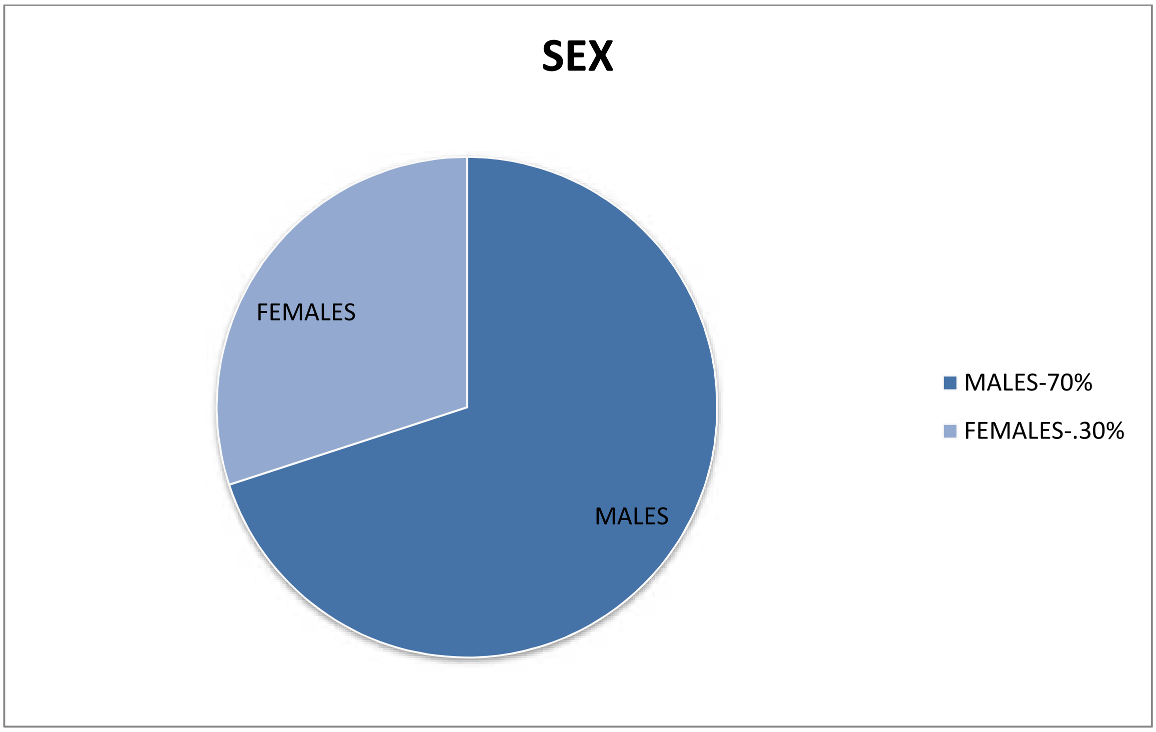
Age group	Number of cases	Percentage
20-30	2	10%
31-40	4	20%
41-50	6	30%
51-60	6	30%
61-70	2	10%



II.SEX DISTRIBUTION

Males are more affected in our study compare to females.

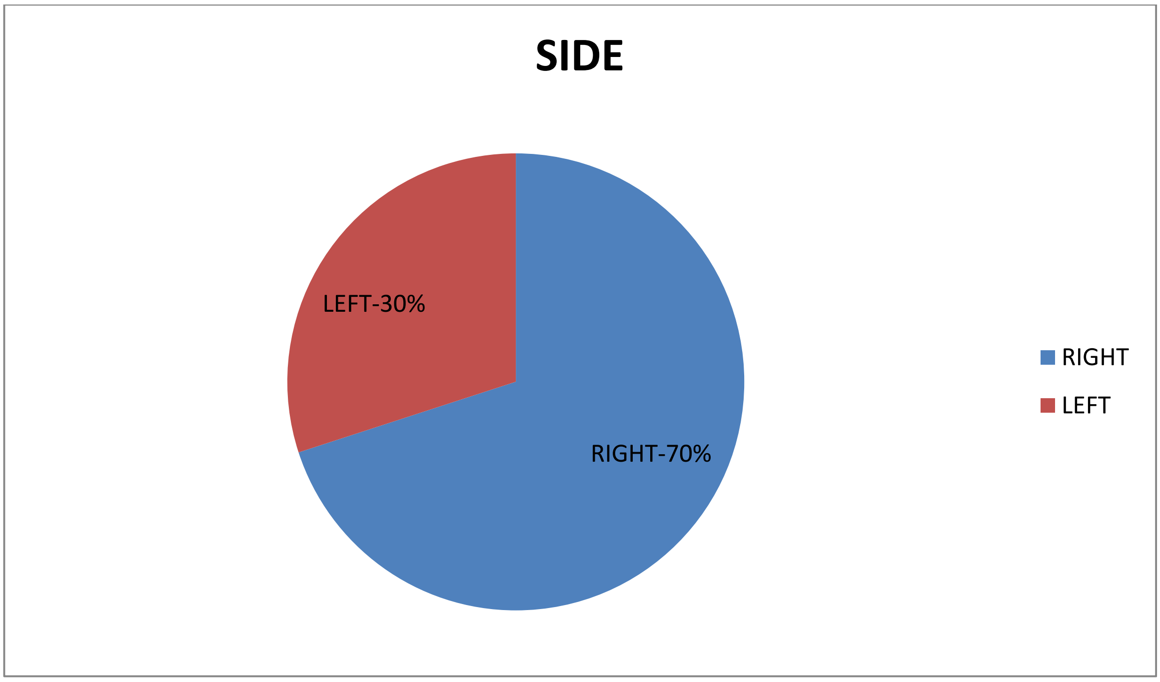
Sex	No. of cases	Percentage
Male	14	70%
Female	6	30%



III.SIDE OF INJURY

Right side was common in our study

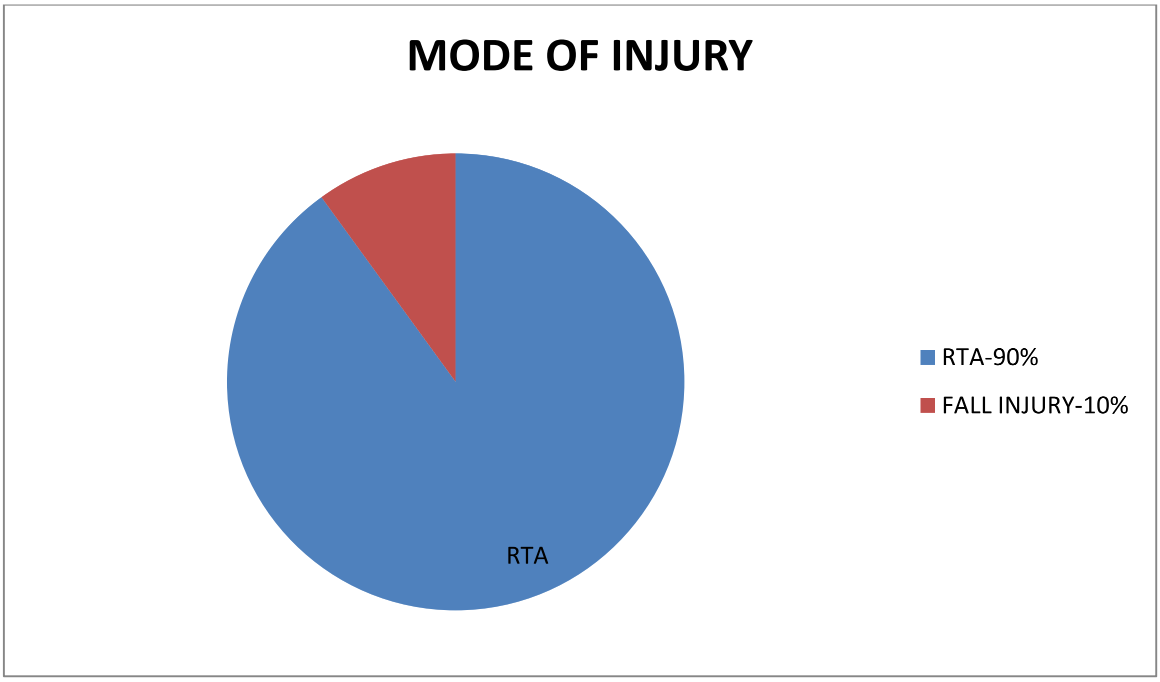
Side	No. of cases	Percentage
Right	14	70%
Left	6	30%



IV.MODE OF INJURY

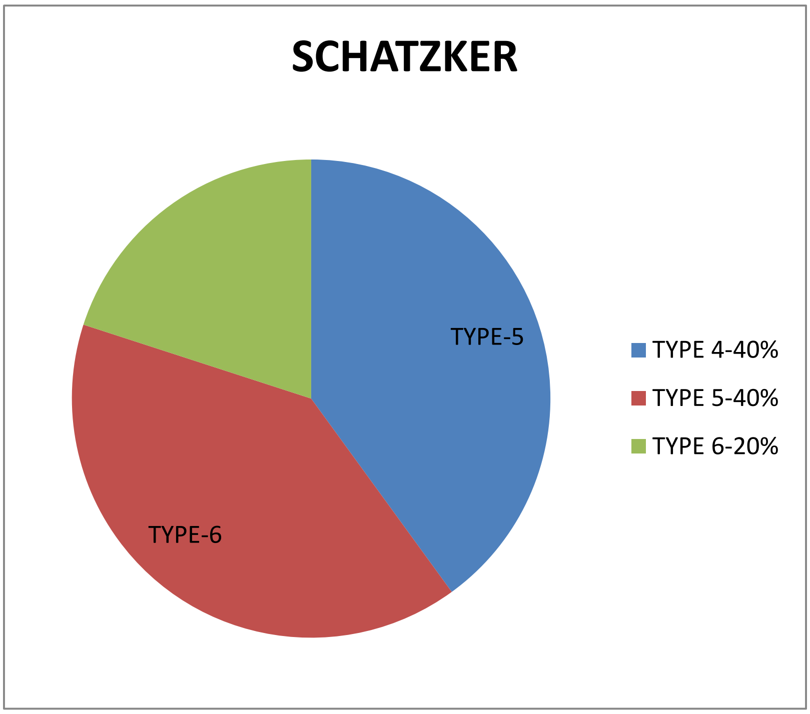
Commonest mode of injury was RTA

Mode of injury	No. of cases	Percentage
RTA	18	90%
Fallinjury	2	10%



V.CLASSIFICATION OF FRACTURES

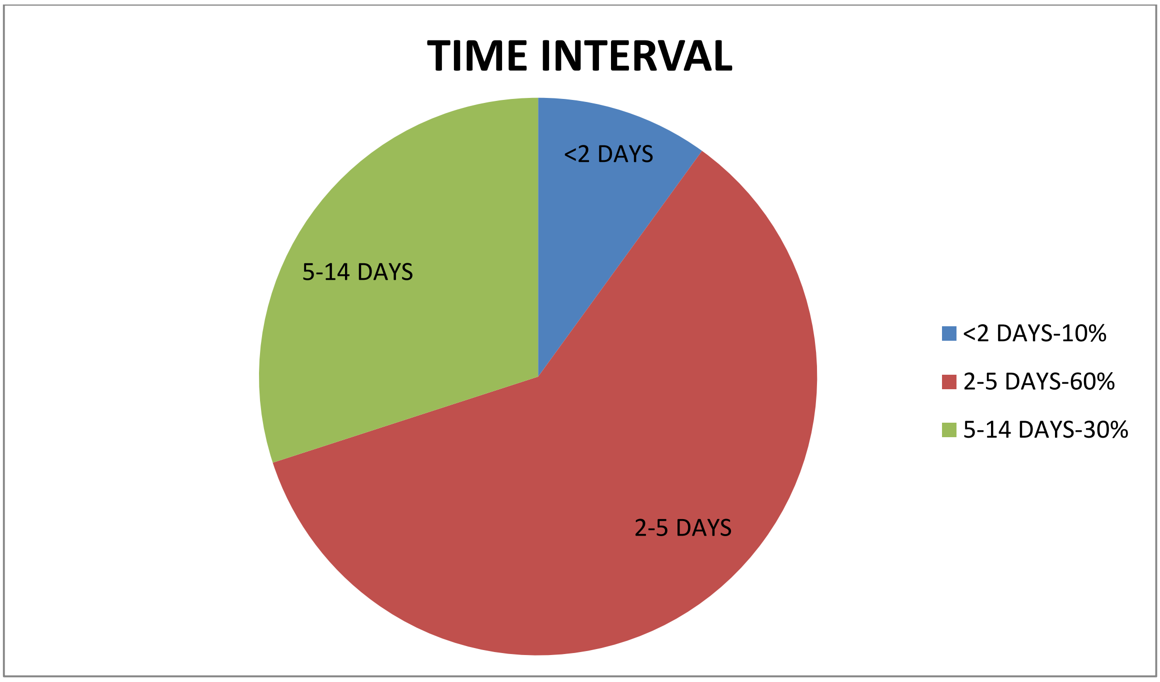
Schatzker classification	No. of cases	Percentage
Type 4	8	40%
Type 5	8	40%
Type 6	4	20%



VI.TIME INTERVAL BETWEEN INJURY AND SURGERY

Usually the time interval between injury and surgery was 2 to 5 days

Time interval	No. of cases	Percentage
<2 days	2	10%
2 to5 days	12	60%
5 to 14 days	6	30%

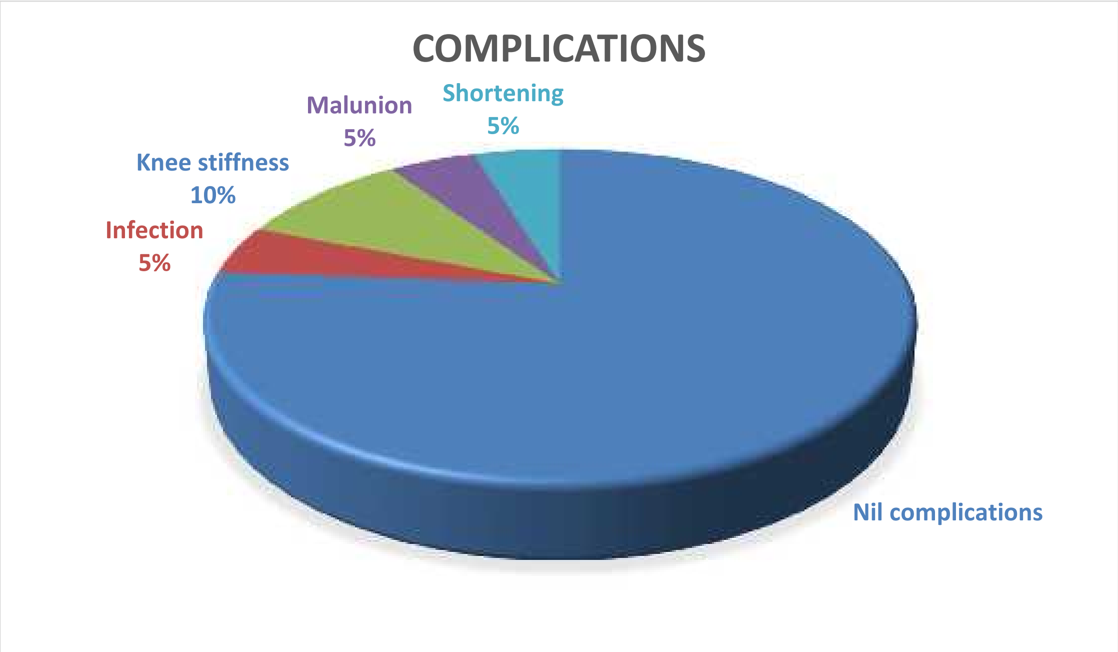


VII.ASSOCIATED INJURIES:

1. Humerus fracture -1
2. Fracture both bone forearm-1
3. Colles fracture -1

VIII : COMPLICATIONS

Complications	No of cases	Percentage
Nil complications	16	80%
Infection	1	5%
Knee stiffness	2	10%
Malunion	1	5%
Shortening	1	5%



POST OPERATIVE PROTOCOL

After surgery the limb was kept in elevated position. The timing of knee rehabilitation was based on

a. Fracture pattern
b. Bone quality
c. Stability of fixation
d. Patient compliance

Second post operative day:

Knee bending exercises started along with quadriceps exercises. Ankle pump exercises to avoid DVT and to promote limb circulation. If fixation was stable with, good bone quality, patient can be allowed for partial weight bearing. In our cases because fracture pattern was associated with comminution weight bearing delayed till radiographic union.Toe touch walking allowed with the help of walker

For 48 hrs – ankle pump exercises and static quadriceps strengthening exercises.

After 48 hrs – active and passive knee bending exercises started once drain removal and first dressing is changed.

Non weight bearing walking starts one the pain is tolerable.

Suture removal done on 14^{th} post op day.

After 6 weeks:

Regular check up was done for infection, clinical and radiological union

- After radiological signs of union appear full weight bearing was started at an average of 8-12 weeks

FOLLOW UP:

All the patients were followed up carefully watching for any complication every fortnightly till fracture healing. After that every monthly up to 6 months. After that every 3 months.

Outcome evaluated based on Criteria for Rasmussen Radiologic assessment for knee and Oxford knee scoring system.

PITFALLS AND THEIR MANAGEMENT

Wound infection

In our study 1 patient had wound infection. The infection was treated according to pus culture sensitivity report with intravenous antibiotics for 3 weeks followed by 3 weeks of oral antibiotics. Since metaphysical region is richly vascular the infection subsided with daily dressing and appropriate antibiotics. He also had knee stiffness due to poor post op cooperation with mobilization.

Knee stiffness:

In our study 2 patients had stiffness of knee joint because of poor co-operation with knee mobilization exercise and they were treated with mobilization under anesthesia and all cases got good functional range of movement. These patients were given good physiotherapy follow up. Out of 2 patients, 1 patient had knee stiffness following infection.

Malunion:

One case went for valgus malunion. In that case initial fixation was satisfactory but the bone quality was poor and patient started early weight bearing and last the early follow up came for follow-up after 3 months. After 3 months patient present with valgus malunion. This was managed conservatively as the patient was uncooperative.

Shortening

In our study one patient had 1cm shortening due to impaction of the fragments. They were treated with foot wear modification and they did well.

DISCUSSION

The analysis was done using CRITERIA FOR RASMUSSEN RADIOLOGIC ASSESSMENT, OXFORD KNEE SCORING SYSTEM and the following results were obtained CRITERIA FOR RASMUSSEN RADIOLOGIC ASSESSMENT

Grading	No. of cases	Percentage
Excellent	11	55%
Good	8	40%
Fair	1	5%
Poor	0	0

Results according to Schatzker's type

Schatzker's type	No. of cases	RASMUSSENS SCORE
TYPE 4	8	17.5
Type 5	8	15.5
Type 6	4	15

The average time for fracture healing was 10 weeks (ranging from 8 weeks to 12 weeks). Fracture pattern, type of fracture and presence of infection significantly affected the fracture healing. Anatomical reduction and relatively stable fixation had early rehabilitation and reduced complications.

Posteromedial plating in posteromedial column fracture aids in good fracture union and the weight transmission from the femur can be proper and early mobilization is possible. Avoids skin necrosis which was potential problem in proximal tibia fractures. Patient compliance is more.

The average clinical results obtained in our study:

STUDY	**NO. OF CASES**	**EXCELLENT**	**GOOD**	**FAIR**
In our study	20	55%	40%	5%
Mean RASMUSSEN SCORING system			15.5	
Mean Oxford knee scoring system			40.4	

Following plating if the wound gets infected and not properly treated lead to septic arthritis which is most dreaded complication.

Knee stiffness was another notorious complication for proximal tibia fractures. In our study it was 10% even though it looks high study period was too short to commit these results. After the couple of years the range of movements in these patients may improve and functional outcome may go up.

These results are comparable with the various prospective study conducted all over the world , which are shown below

STUDY	NO. OF CASES	EXCELLENT	GOOD	FAIR
Weil Ya, Gardner MJ, Boraiah S	28	55%	41%	4%
Lobenhoffer P, Gerich T, Bertram T	21	57%	42%	1%
Berber R, Lewis CP, Copas D	11	54%	36%	9%
In our study	20	55%	40%	5%

Out of the twenty patients 11 patients had excellent results 8 patients had good results and for one patient result was fair. No patient had poor results. This criteria was based on Rasmussen Radiologic assessment. Of which eight cases were Schatzker type IV who had average Rasmussen's score of 17.5. Eight patients had Schatzker type V proximal tibia fracture and had an average of 15.5 Rasmussen's score. Four patients were diagnosed to have Schatzker type VI proximal tibia Fracture and the Rasmussen's score was 15.

Functional assessment of the post operative patients were assessed with Oxford Knee Scoring System. In our study Mean Oxford Knee score was 40.4 which indicate satisfactory joint function.

Radiological union and results are also compared with other studies. Weil Ya , Gardner MJ, Boraiah S conducted similar study with 28 patients and had 55% excellent , 41% good and 4% fair results. In another study conducted by Lobenhoffer P, Gerich T, Bertram T they had 21 patients and the results were 57% patients had excellent results, 42% with good results. Study of Berber R, Lewis CP, Copas D revealed 54% excellent results, 36% good and 9% fair results. In our study 55% patients had excellent results, 40% good and 5% fair results and hence it shows comparable results with other published studies.

CONCLUSION

The conclusion of this study are

- The high energy tibial plateau fractures are not uncommon fractures
- Due to increased incidence of the road traffic accidents(high velocity injury) occurrence in young patient is increasing
- Frequency of posteromedial fragment in bicondylar tibial fractures are high
- Computerized tomography is a must in evaluvation of proximal tibial fractures.
- Fixation of the poseromedial fragment through posteromedial approach with a strong locking plate is mandatory if present to give more stability to knee.
- Posteromedial approach and necessarily combined anterior approach have significant value for the management of comlex unstable tibial plateau fractures.
- Knee stability is the most important factor for good prognosis
- **The advantagesof posteromedial plating are:**

  a) Early mobilization

  b) Avoid soft tissue necrosis

  c) Allows direct and accurate fracture reduction

  d) Increases knee stability and functional outcome

e) Allows adjunctive procedures like lateral plating , cancellous screw fixation.

An adequate surgical technique will minimize complications and an aggressive rehabilitation regime will ensure the best possible result. The surgeon's familiarity with the implant chosen also plays an important role. Accurate anatomical reduction of the articular surface and stable fixation mandatory for better functional outcome. In general posteromedial plating in posteromedial column fractures is a relatively new concept following CT evaluvation, treatment for high-energy tibial plateau fractures does very well in this form of injuries. It allows anatomical reconstruction of the articular surface, stable fixation of fracture fragments, early rehabilitation of the joint, and care of associated soft tissue injuries, without a high rate of complications.

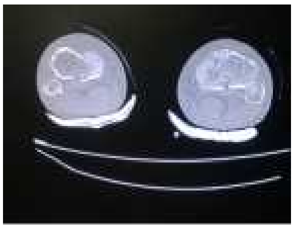
LIMITATIONS

The follow up time in our study was relatively short and it was not a randomized controlled study.

CASE 1
PREOP RT SIDE

PRE OP Lt Side

CT SCAN



INTRA OP

POST OP

2 MONTHS

1 YEAR

CASE 2

POST OP

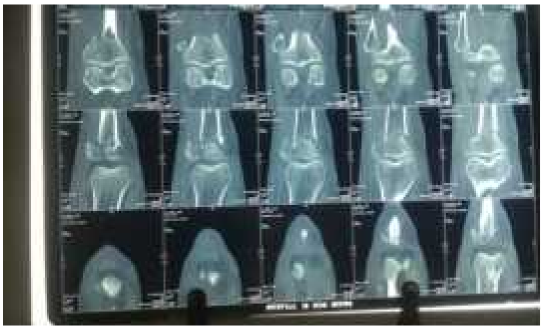
2 MONTHS

6 MONTHS

 **1 YEAR**	 **1 ½ YEARS**
	
	

CASE 3

CT SCAN



POST OP

2 MONTHS

6 MONTHS

1YEAR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2 YEARS



CASE 4


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MURUGANANTH
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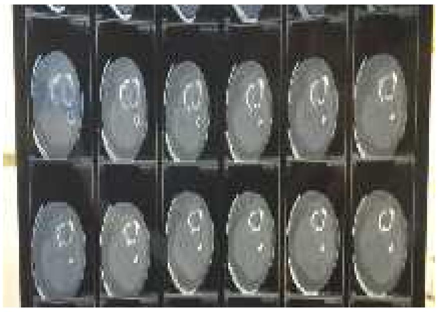
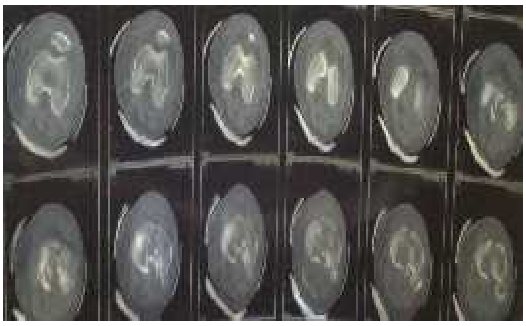
POST OP

CASE 5





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Sl. no	NAME	AGE / SEX	DIAGNOSIS	PROCEDURE	COMPLICATION	UNION	RASMUSSEN SCORE	OXFORD KNEE SCORE	RESULTS	MODE OF INJURY
1	Umakani	48/F	Schatzker type V tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	43	excellent	RTA
2	Ramamoorthy	52/M	Schatzker type IV tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	46	excellent	RTA
3	Ramamoorthy2	52/M	Schatzker type IV tibial plateau L side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	46	excellent	RTA
4	muruganantham	56/M	Schatzker type IV tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	44	excellent	RTA
5	Ravi	32/M	Schatzker type IV tibial plateau L side	posteromedial LCP	NO	2 months	18	45	excellent	RTA
6	Karuppasamy	39/M	Schatzker type IV tibial plateau L side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	44	excellent	RTA
7	Arumugham	24/M	Schatzker type IV tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	44	excellent	RTA
8	Thangavel	36/M	Schatzker type V tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	16	38	good	RTA
9	Pandaram	63/M	Schatzker type VI tibial plateau R side	posteromedial LCP+ lateral buttress LCP	infection + Knee stiffness	2 months	10	26	fair	fall injury
10	Selvi	44/F	Schatzker type V tibial plateau L side	6.5 cancellous screw + posteromedial LCP	NO	2 months	16	37	good	RTA

Sl. no	NAME	AGE / SEX	DIAGNOSIS	PROCEDURE	COMPLICATION	UNION	RASMUSSEN SCORE	OXFORD KNEE SCORE	RESULTS	MODE OF INJURY
11	Antonyraj	27/M	Schatzker type IV tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	14	38	good	RTA
12	Balammal	66/F	Schatzker type VI tibial plateau R side	posteromedial LCP + lateral buttress LCP	NO	3 months	16	36	good	Fall injury
13	Parvathi	48/F	Schatzker type V tibial plateau L side	6.5 cancellous screw + posteromedial LCP	Knee stiffness	2 months	18	44	excellent	RTA
14	Mani	39/M	Schatzker type IV tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	3 months	18	45	excellent	RTA
15	Muthu	46/M	Schatzker type V tibial plateau R side	6.5 cancellous screw + posteromedial LCP	Malunion	2 months	14	37	good	RTA
16	Lakshmi	55/F	Schatzker type VI tibial plateau L side	6.5 cancellous screw + posteromedial LCP	Shortening	2 months	18	46	excellent	RTA
17	Durai	52/M	Schatzker type VI tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	3 months	16	39	good	RTA
18	Chinnasamy	43/M	Schatzker type V tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	14	33	good	RTA
19	Velammal	59/F	Schatzker type V tibial plateau R side	posteromedial LCP + lateral T buttress LCP	NO	3 months	16	33	good	RTA
20	Mariappan	47/M	Schatzker type V tibial plateau R side	6.5 cancellous screw + posteromedial LCP	NO	2 months	18	44	excellent	RTA